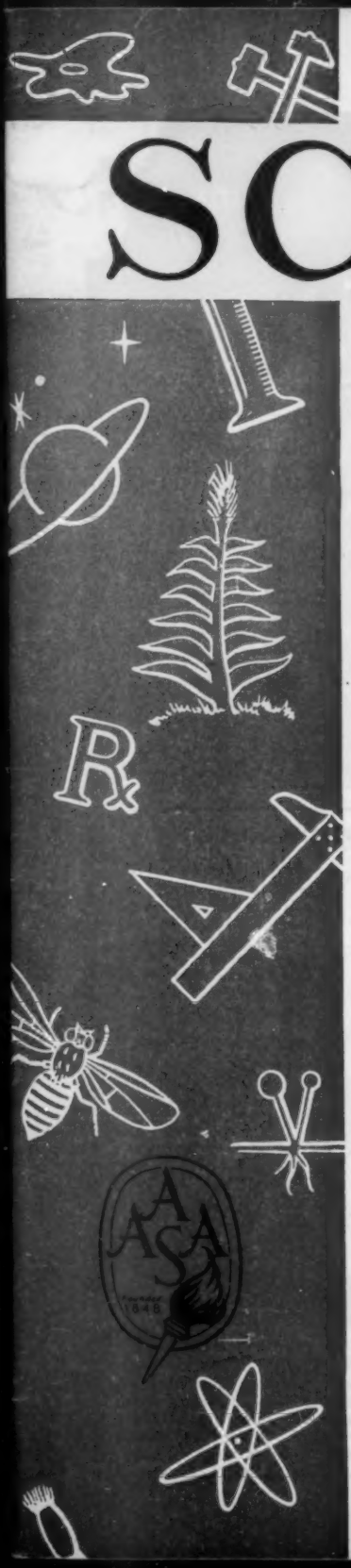

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Contents

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Chicago Radiocarbon Dates, IV

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THE DATES OBTAINED since the publication of our first three date lists (*1–4*) are presented below. This list covers the period September 1, 1952, to September 1, 1953. The dates quoted are based on 5568 ± 30 years as the half-life of radiocarbon (*3*). The number of runs is indicated by the number of dates listed, unless they were merely remeasurements of the carbon obtained from an earlier combustion, in which case brackets are placed around the set of dates involved. Remeasurement always involved rewashing the sample with acid for cleaning; otherwise, separate portions of the original samples were processed and measured. Counting time has been limited to 48 hours except in the case of the sample from Nippur.

The numbering of samples and the file names we have used (which appear in parentheses when two names are given) are entirely our own and not those of the donors and collaborators. We prefix "C" to our numbers to distinguish them from the sample numbers from other laboratories.

RADIOCARBON DATES

Our No.	Sample	Age (years)
I.	*Mesopotamia and Western Asia* (Principal collaborator: R. J. Braidwood)	
	A. Egypt	
C-810	*Nagada* (*Predynastic Hair I*): Human hair weighing about 3 ounces, found in a cemetery at Nagada in Southern Egypt in 1896. This material belongs to Predynastic Egypt, that is, is older than about 5000 years. The British archaeologist W. Flinders Petrie constructed a scheme of what he called Sequence Dates, on the basis of changing pottery styles, dividing the Predynastic period of Egypt into 80 Sequence Dates. This sample consisted about	5744 ± 300

[1] The author gratefully acknowledges the generous financial support of the John Simon Guggenheim Memorial Foundation, the Geological Society of America, and the Wenner-Gren Foundation for Anthropological Research, a portion of whose original grant still remains. He also wishes to thank the members of the Committee on Carbon 14 and the several other archaeologists and geologists who have given advice about selection and identification of samples from time to time. Mr. Jonathan Gell burned and reduced the samples this year. His meticulous care contributed immeasurably to whatever usefulness these data may possess.

RADIOCARBON DATES—(*Continued*)

Our No.	Sample	Age (years)
	half of material from Grave 1592 with a Sequence Date of 34; one-quarter from Grave 1487 with a Sequence Date of 38; and the rest from Graves 1562 (Sequence Date 35) and 1816 (Sequence Date 35). Submitted by Miss Margaret Armit, Department of Archaeology and Ethnology, Cambridge University, England.	
C-814	*Nagada* (*Predynastic Skin*): Human skin weighing about 2 ounces, found in a cemetery at Nagada in Southern Egypt in 1896, as in the case of Sample 810. This material came from Grave 1609 with a Sequence Date of 34 to 38. Submitted by Miss Margaret Armit.	5577 ± 300
	C. Iraq	
C-752	*Nippur* (*Nippur I, II, III*): In the case of this sample a serious attempt was made to test the limit of sensitivity of the radiocarbon dating method. An important subject, the time of Hammurabi of Babylon, was selected and the sample, which consisted of a charcoal beam from the roof of a house definitely fixed in the Hammurabian calendar, was divided into 3 equal portions and each portion measured as a separate individual for nearly one month of steady counting time. The total time of 3 months spent in this investigation we hope has served to establish the true limiting accuracy of the method as now developed. The dating of the time of Hammurabi of Babylon is approached by dating the associated kings Ibi-Sin and Shu-Sin, who lived about 250 years before Hammurabi, but at a time accurately known on the Babylonian calendar. Hence a date for Ibi-Sin or Shu-Sin correspondingly fixes the date of accession of Hammurabi.	3945 ± 106

Our No.	Sample	Age (years)
	The material used was charcoal which was excavated in Nippur by Donald E. McCown of the Oriental Institute, University of Chicago, in March, 1950, at Area TB, locus 195, level IV, floor 2. The charcoal came from a roof beam of a house of level IV, floor 2. The archaeological situation of dated tablets makes it highly probable that this building was constructed not later than Year 3 of Ibi-Sin or earlier than Year 1 of Shu-Sin (a range of 12 years). The point at issue chronologically is that while the Mesopotamian king list on the Babylonian calendar is internally reliable, it is in itself a floating chronology. Hence, for example, the dates for the accession of Hammurabi of Babylon as currently given by various authors cover a range of at least 350 years. The date is thought to be important historically, not only for strictly Mesopotamian problems but for the whole interwoven fabric of historic interrelationships of western Asia and Egypt in the early part of the second millennium B.C. The results for the 3 portions of charcoal were 4.029 ± 0.05, 4.085 ± 0.07, and 4.156 ± 0.13 counts per minute. Modern wood gives 6.68 counts per minute. The question one considers first is whether the 3 determinations agree within the counting errors, for the errors indicated above are calculated solely on the basis of the square root of the total number of counts taken, this being the standard deviation within which the true value has a two-thirds probability of being found. It certainly is a minimum error. These are the errors quoted above. It does seem that the 3 determinations do agree within their individual counting errors and that therefore the samples are uncontaminated by extraneous radioactivity. If one were certain that the errors lay principally in the counting, the mean of the 3 determinations should be taken by using the inverse square of the counting errors as weighting factors. The weighted average taken in this way is 4.060 ± 0.042, for an age of 4004 years ± 106 years, or 2052 ± 106 B.C.	

Our No.	Sample	Age (years)
	It is probably better, however, to take the arithmetical average since there are undoubtedly other errors than the counting errors. The arithmetical average is 4.090 ± 0.04. In striking this average we use the same calculation for the error used for the weighted average, since the errors quoted throughout are determined solely by the counting error. The latter mean corresponds to an age of 3945 ± 106 years, or 1993 ± 106 B.C. The error 0.04 corresponds to 80 years in itself, but an estimated 0.54% error in the half-life of radiocarbon and 0.67% in the assay of modern wood must be included. Combining, we obtain 106 years. Our conclusion is that this sample of charcoal came from wood which was cut or ceased to live about 3945 years ago. More definitely, we conclude that for 2 chances out of 3 it died between 2100 and 1887 B.C., and for 19 chances out of 20 it died between 2205 and 1781 B.C. Since the allowable range from other evidence seems to be 2375 to 1975 B.C., we conclude that the younger of the possible calendars is strongly favored by the radiocarbon dating. The odds against a result 130 years higher than the mean are about 9 to 1. Sample submitted by Donald E. McCown.	
C-818	*Hazer Merd*: Charcoal ash sample from the "Mousterian" level of the Hazer Merd cave in Sulimaniyah, Iraq. This cave was excavated by Miss Dorothy Garrod in 1928 (*Bull. Am. School Prehist. Research*, 6, 24–37 [1930]). The sample was collected by Mrs. Linda Braidwood and Bruce Howe in April, 1951, from Layer C of the exposed trench face which still showed the dark ash lines shown in Miss Garrod's published section. One of these ash lines was cleaned and the sample taken from it. Submitted by R. J. Braidwood, Oriental Institute, University of Chicago.	Older than 25,000
	G. Afghanistan	
C-815	*Mundigak* (*Afghanistan Bronze Age*): Charcoal from the prehistoric site of Mundigak in the province of Kandahar, excavated by the expedition headed by M. J. M. Casal. Came from	4720 ± 270 4439 ± 280 Av 4580 ± 200

Our No.	Sample	Age (years)
	Layer 23, which is certainly at the very beginning of the Bronze Age and possibly a little earlier. The Afghanistan chronology is unknown prior to the Hellenistic contact (Alexander the Great). The painted pottery of the basal levels is similar to the late prehistoric pottery of Iran in a general way. A date for this material would add to the general understanding of the area itself, which is otherwise undatable, and to a better grasp of Near East-Indus Valley relationships, which will probably be cleared up best by understanding the intervening regions of Baluchistan and Afghanistan. Submitted by Daniel Schlumberger, Director of the French Archaeological Expedition in Afghanistan, Kabul, Afghanistan.	
	H. Lebanon	
C-819	*Byblos*: Wood from a house in the ancient Lebanese city of Byblos. This sample comes from a level identified as "First Urban Installation" of Byblos, which is to be taken as being roughly equivalent to what is called the Early Bronze Age I in Palestine, which should be about the time of the Late Predynastic-Early Dynasty I of Egypt. The port of Byblos was probably an important trading center at that time. There is evidence of trade contact between Egypt and Syria. This material is expected to be roughly contemporaneous with Sample C-627, Hemaka, which dated 4883 ± 200. Submitted by M. A. Dunand, French Embassy, Beirut, Lebanon, via R. J. Braidwood.	5317 ± 300
III.	*United States*	
	(Principal collaborators: E. S. Deevey, Jr., R. F. Flint, J. B. Griffin, R. F. Heizer, F. Johnson, F. H. H. Roberts, and W. S. Webb)	
	B. New York State	
C-794	*Pt. Peninsula*: Charcoal from the Hunter Site on Red Lake in Jefferson Co., N. Y. This charcoal represents a residue of a crematory fire. Small bits of what appear to be burned leather shroud fragments are included. The particular grave yielding the samples submitted	4881 ± 400 3920 ± 300 Av 4400 ± 260

Our No.	Sample	Age (years)
	was one of several closely clustered on a sand ridge adjacent to a group of stone crematories. The cremated bones, charcoal, offerings, etc., had been scooped from the crematories and buried in graves ranging in depth from 30″ to 74″. This sample occurred in burial No. 1 at depths from about 25″ to 30″ from the surface, in direct association with cremated bones and grave goods, and was covered by clean, moist, undisturbed sand. There is no doubt as to its source or provenience. The total assemblage in the light of diagnostic grave goods is Pt. Peninsula 2 Focus, or classic Pt. Peninsula in New York, Ontario, and elsewhere in the northeast. (See Ritchie, W. A. *American Antiquity*, 17, No. 2, Oct., 1951, pp. 130–136). This material was collected and submitted by W. A. Ritchie, New York State Museum, Albany.	
	C. Illinois, Indiana, Iowa, Kentucky, Ohio, and Pennsylvania	
C-759	*Kentucky Adena I*: Charcoal from an Adena mound at Dover, Mason Co., Ky., Site Ms 27. The charcoal came from a large heavily burned area near the top of the mound core. It bears the donor's sample No. 117 (V 42). Collected and submitted by W. S. Webb, University of Kentucky.	2650 ± 170
C-760	*Kentucky Adena II*: Charcoal associated with Burial No. 55 in the Adena mound at Dover, Mason Co., Ky., Site Ms 27. Burial No. 55 was a redeposited cremation near the mound base outside the skirt of the mound core, and was all covered by a heavy earth mantle. This sample bears the collector's sample No. 148 (V 38). Collected and submitted by W. S. Webb.	2260 ± 220 2078 ± 290 Av 2169 ± 175
C-801	*Glenwood*: Wood from beach deposits apparently of the Glenwood stage of glacial Lake Chicago, found 1 mile west of Dyer, Ind., NE ¼ Sec. 30, T35N, R15E, Ill. The specimens were found at a depth of 8′ in a deposit of beach ridge sand and gravel containing associated lagoonal depos-	10,661 ± 460 11,284 ± 600 Av 10,972 ± 350

Our No.	Sample	Age (years)
	its. The thickness of the deposit ranges from 6′ to 18′, and has a composition dominantly of inclined beds of sand and gravel with thin interbedded layers of silt and fine sand. Following Bretz, the deposits of the Glenwood stage are considered to be late Cary age. Collected and submitted by Leland Horberg, University of Chicago.	
	E. Louisiana, Mississippi, Missouri, Nebraska, and Texas	
C-822	*Cedar Canyon*: Charcoal from "soil" and hearth at the base of Terrace 1 fill from site Sx-107, Cedar Canyon area, Sioux Co., Neb. This charcoal was collected in 1951 by Tanner, Lueninghoener, and Schultz. It should furnish a date for the basal part of the Terrace 1 fill. The earlier Sample 469 from the same locality, which dated 2379 ± 430 and 1993 ± 190, was from the middle of the Terrace 1 fill. The exact location from which the charcoal was taken was near the center of Sec. 16, T33N, R53 W. (See Fig. 26, p. 186 and plate XV, p. 192, of "Pleistocene and Postglacial Mammals of Nebraska," by E. H. Barbour and C. B. Schultz, in: *Early Man*, Lippincott, 1937.) Submitted by C. B. Schultz, University of Nebraska Museum.	2049 ± 180
	F. Arizona, California, Colorado, and New Mexico	
C-763 C-764 C-771 C-777 C-787	*Rotten Modern Wood*: The question of alteration of the radiocarbon assay by rotting and putrefaction processes was tested by measuring these samples, submitted by Dr. Ernst Antevs, The Corral, Globe, Ariz. The modern world-wide assay on our counters is 6.68 counts per minute.	
		Assay
C-763	Dead branch from a live mesquite tree.	6.73 ± 0.2 cpm
C-764	Same dead branch as 763, but burned to charcoal.	6.39 ± 0.5
C-771	The decomposed interior of a Gambel oak tree from Lakeside, Ariz.	6.76 ± 0.17
C-777	The decayed center of a Ponderosa pine.	6.83 ± 0.12
C-787	Partly decomposed root of a Ponderosa pine.	6.73 ± 0.14

Our No.	Sample	Age (years)
C-691	*Johnson Site*: Charcoal from the Johnson Mound Site near Sacramento, Calif., Sac-6, Trench Z, Excavation Unit 8, depth 36″ to 48″. The charcoal sample actually came from a burned post embedded in the floor of a house. This site is a Late Horizon site and the period covered by this culture has been assumed to be included in the past 1500 years. Submitted by R. F. Heizer, University of California, Berkeley.	2360 ± 400 2460 ± 165 Av 2410 ± 200
C-690	*Coyote Hills*: Charcoal from a refuse midden in the Coyote Hills site near Newark, Alameda Co., Calif. This was Site Ala-328, and the midden was located in Pit 5A at the base of the culture deposits at a depth of 11′ from the surface. The culture affiliation is Middle Horizon, as defined by R. K. Beardsley in an article in *Am. Antiquity*, 1948. Submitted by R. F. Heizer.	2588 ± 200 2090 ± 220 Av 2339 ± 150
C-616	*Searles Lake*: Sample C-615 consisted of organic matter from a mud seam separating the upper and lower salt deposits of Searles Lake, Calif. It is believed that the layer of organic matter was deposited by flood waters during the recession of the glaciers. The organic matter was extracted with acetone and evaporated to a thick syrup, and the resinous material precipitated by adding distilled water. Sample C-615 dated at least 16,000 years old. The present sample was prepared in the same way, but from mud just below the lower deposit of soluble salts, and therefore, of course, should be considerably older than Sample C-615. Collected and submitted by W. A. Gale, American Potash and Chemical Corporation, Trona, Calif.	Older than 19,000
C-823	*Burnet Cave*: Charcoal from Burnet Cave, Guadalupe Mountains, Eddy Co., N. M. The sample came from the 8′ to 9′ level in the fill of this cave. The sample should aid in determining the time of the extinction of the horse, the bison, the camel, the cave deer, the 4-horned antelope, and the musk oxen in the southwestern region of the Great Plains.	7432 ± 300

Our No.	Sample	Age (years)
	The animals found in this cave are northern forms which had been driven south by the advance of the Mankato ice sheet. The cave is described in Schultz and Howard, "The Faunas of Burnet Cave, Guadalupe Mountains, New Mexico," (*Proc. Acad. Natl. Sci. Phil.* **87**, 273 [1935]). The sample was collected in 1937 by E. B. Howard, R. M. P. Burnet, and Mr. and Mrs. C. Bertrand Schultz. Submitted by C. B. Schultz.	
	H. Minnesota, Wisconsin, and Wyoming	
C-702	*Muddy Creek*: Charcoal from an ancient hearth in a camp site found near the mouth of Muddy Creek, a tributary of the Big Horn River just above Boyson Dam, Wyo. The material was found in Site 48Fr 34 at the location NO37.3x EO36.6 in the Lower Level. The site is in the Shoshoni Basin. Submitted by William Mulloy, University of Wyoming.	3540 ± 220
C-711	*Upper Muddy Creek II*: Charcoal from an ancient hearth found on Muddy Creek several miles above Site 48Fr34 (cf. Sample C-702). The number of the hearth was 35, and the site is numbered 48Fr33. Submitted by William Mulloy.	3350 ± 250
C-712	*Poison Creek*: Charcoal from a hearth found in an ancient camp site at the mouth of Poison Creek, a tributary of the Big Horn River just above Boyson Dam in Wyo. The hearth was No. 1 in Site 48Fr5. Submitted by William Mulloy.	3506 ± 220
C-715	*Wind Creek*: Charcoal from a hearth in an ancient camp site found between Wind Creek and Mule Creek near the mouth of Mule Creek, which is a tributary of the Belle Fourche River just above Keyhole Dam in Wyo. The site was 48Ck7, the hearth was No. 23, and the charcoal came from the Upper Level. Submitted by William Mulloy.	3287 ± 600
C-790	*Grasshoppers*: Grasshoppers found frozen in Grasshopper Glacier, Yellowstone National Park, Wyo. They occurred well down towards the central and bottom portion and were removed and melted out by Irving Friedman of the U.S. Geological Survey. These grasshoppers were first reported in 1898 by Kimball. They are identified as *Melanoplus mexicanus mexicanus* (Sauss.), which is widely distributed and is the common grasshopper pest. In the 1870's and 1880's this species was particularly destructive on the Great Plains and in the northern Rocky Mountain region. It was very conspicuous because of pronounced migratory habits. In recent years it has migrated very little, presumably due to changing agricultural practices. The specimens preserved in the glacier apparently are of the migratory sort. Submitted by Irving Friedman.	45 ± 150
C-795	*Horner Site*: Charcoal from the Horner Site (Sage Creek Site), Park Co., Wyc. (cf. Sample C-302, which dated 6876 ± 250 years). This sample was collected in a heavily burned area which probably represented a hearth or fireplace. It was located in Square 9L-D. The site number is 48PA29. The Horner Site located near Cody, Wyo., was a butchering site of the ancient Indians. By August 1950 about 180 bison skeletons had been recovered. Apparently the animals were slain in the fall of the year. The stone projectile points found in this site were of the Scotts Bluff and Eden types. Collected by the Princeton-Smithsonian Expedition in the summer of 1952. Submitted by Waldo R. Wedel, Smithsonian Institution.	6151 ± 500 7690 ± 850 Av 6920 ± 500
C-800	*Appleton*: Pleistocene wood from Appleton, Wis., SE ¼ Sec. 28, T21N, R17E, found below plain of glacial Lake Oshkosh, embedded in a diagonal position in clayey red Valders till. The bark still remained on some of the log. From this Professor Read of Lawrence College, who collected the material, concluded that the wood could not have been transported very far before burial. Associated deposits include proglacial lake silts and sand and gravel. It was identified as spruce (*Picea*) by L. R. Wilson, Uni-	11,471 ± 500 10,241 ± 650 Av 10,856 ± 410

Our No.	Sample	Age (years)
	versity of Massachusetts. It was found at a depth of 14′ below the plain of Lake Oshkosh. Submitted by Leland Horberg.	
	J. Alaska	
C-792	*Denbigh Flint I*: Charcoal from the Denbigh Flint Complex in the site at Iyatayet, Alaska. The layer from which the sample came was covered at the point of sampling by sterile sandy silt, a layer of peaty material, and then by silt loam containing "palae-Eskimo" and "neo-Eskimo" materials. The depth of the layer in this section was between 6½′ and 7′. The sample was scraped from the Complex in place in Section IYZ-5B near the middle of the terrace. It was collected and submitted by J. L. Giddings, University of Pennsylvania Museum.	3477 ± 310 3541 ± 315 Av 3509 ± 230
C-793	*Denbigh Flint II*: Charcoal from the Denbigh Flint Complex in the site at Iyatayet, Alaska (cf. Sample C-792). The layer at this point was covered by 4½′ of soil including Eskimo materials above the usual sterile layer. This section, labeled Section IYR, is high on the terrace slope where later cultural materials were thinly deposited. It is about 50′ from the section in which Sample C-792 was collected. Collected and submitted by J. L. Giddings.	4253 ± 290 5063 ± 340 Av 4658 ± 220
V.	*Central and South America*	
C-799	*Guatemala*: Charcoal from a log at the base of a very thick deposit of pumice laid down by glowing volcanic avalanches in Guatemala. The material was collected by Edwin Shook of the Carnegie Institution of Washington. It was found on the west edge of the highway between Patzun and Godinez, Department of Chimaltenango, above Rio Chocoyos at the 6000′ level in Chocoyos Cañon in Guatemala. The sample was from a location near the bottom of a deposit of fine to thumb-size white pumice. It was 15 cm in diameter and 8 m long. The importance of the specimen is that it serves to date the colossal glowing avalanche deposit west of Lake Atitlan. Similar deposits probably of about the same age, to judge by their degree of erosion, are widespread north of Lake Atitlan, also in the great valley around Guatemala City, and in the valley extending west from Totonicapan and in the valley north of Quetzaltenango. In brief, many of the largest valleys of Guatemala were inundated to a great depth by these avalanches during post-Pleistocene times. It is the opinion of Howel Williams that dating of the sample will serve to date, if only approximately, all the other valley fills. L. C. Stuart says the nonoccurrence of charcoal above this sample indicates that no major eruptions have occurred there since. Submitted by Howel Williams, University of California.	Older than 16,000
VII.	*Other Areas*	
C-688	*Chaney Seeds*: Wood (*Torreya nucifera*) from a canoe found about 20′ below the surface in Kemigawa in 1948. This site is 8 miles east of Tokyo. The interest in this wooden canoe stems largely from the fact that Dr. Ichiro Ohga found 3 viable lotus seeds (cf. Sample C-629) associated with the remains of the canoe. In addition to the viable seeds he found many lotus receptacles. Ohga's discoveries were made in April, 1951. The samples were submitted by R. W. Chaney, University of California, Berkeley.	3052 ± 200 3277 ± 360 Av 3075 ± 180
C-661	*Barotseland*: Charcoal from newly developed pit in the Lonze Forest, Barotseland, taken at a depth of 10′ to 10′ 4″ at the site from which Sample C-660 was taken. Sample C-660 dated 3585 ± 260. Collected by Desmond Clark, Livingstone, Northern Rhodesia. Submitted by H. L. Movius, Jr., Harvard University.	3210 ± 250 4300 ± 500 Av 3500 ± 225

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2. Libby, W. F. *Ibid.* **114**, 291 (1951).
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4. ———. *Science* **116**, 673 (1952).

Carbon-13 Variations in Sequoia Rings and the Atmosphere

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RECENTLY THE WRITER presented data on the isotopic composition of carbon in some 80 specimens of modern and fossil plants and coal (*1*). Modern land plants displayed a range of composition amounting to some 0.7 percent of the ratio C^{13}/C^{12}; the average depletion in C^{13} with respect to atmospheric carbon dioxide was found to be about 1.8 percent. Coal samples, and specimens of fossil wood up to 25,000 years or more in age fell within the range of modern wood, though the fossil woods showed a tendency to be slightly enriched in C^{13} with respect to the modern wood average. There was no correlation of isotopic composition with age, and the data and precision of analysis thus implied that the mean isotopic composition of atmospheric carbon dioxide has not varied by more than about 0.2 percent during the last 25,000 years and in fact has probably been constant to about this degree since Pennsylvanian time.

Plant specimens of the same species from different localities, and of different species from the same locality showed differences in isotopic composition; thus composition ranges as used above will include certain intrinsic variations due to species, individual, and geography. These factors can be eliminated by analyzing wood from the radial growth of a single tree; one is then concerned only with variations in the atmospheric carbon dioxide, of interest to the geochemist, and with variations in the isotopic fractionation of the plant, of possible interest to plant physiologists. These two effects may be additive or subtractive, and one will of course observe the resultant; we are interested in whether a steady trend in isotopic composition is observed, or only variations about a mean value. In the latter case the data would indicate that neither the isotopic composition of the atmospheric CO_2 nor the fractionation factor of the tree changed systematically with time, except in the unlikely event that the effects had just cancelled each other. It was felt that the oldest possible tree, that is, a sequoia, should be analyzed first in order to obtain the gross variation over the maximum time span available.

[1] The author thanks Dr. E. Schulman for dating and furnishing the specimen of *Sequoia* and for examining the isotopic data for possible correlation with climatic indices; his active interest was a very real contribution to the work. Dr. H. Suess first suggested the *Sequoia* study to the writer, who is indebted to him and to W. F. Libby and H. C. Urey for informative discussion and criticism. The isotope research program in the laboratories of H. C. Urey was supported by the Atomic Energy Commission (Contract AT(11-1)-101) and the Office of Naval Research (Contract N8ori-02028, Task Order No. XXVIII) while this work was in progress.

A complete radial of one of the oldest sequoias was obtained through the courtesy of Professor Edmund Schulman of the Laboratory of Tree-Ring Research, University of Arizona. He very kindly dated the rings of the radial specimen from the original dating of the tree by A. E. Douglass. Successive rings were cut out of the radial at approximately fifty-year intervals, and the central portions, carefully separated from the exterior parts to avoid contamination, were combusted to carbon dioxide and analyzed in the mass spectrometer in the manner previously described (*1*). In some cases where the rings were very thin, two or three rings were used for one sample. About 14 mg of wood were used for each sample, and in each case care was taken to include the full thickness of the ring or rings in the sample.

The specimen analyzed is *Sequoia gigantea* from the Enterprise millsite, Springville, California, near the southern limit of the strip in the Sierra Nevadas in which these trees grow. This particular tree is Huntington's tree number 195 (*2*) and Douglass has used the notation D-22 for the specimen (*3*, *4*). The first complete ring was dated by Douglass as 1087 B.C. (*3*), and he was later able to establish that the missing central growth dated from 1115 B.C. (*4*, p. 26). Thus some 28 years are missing from the beginning of the record. The rings extend to A.D. 1883+ but beyond A.D. 1650 the wood begins to be badly decayed and analyses were not made beyond this point. The interval over which the analyses extend is thus from 1072 B.C. to A.D. 1649, a span of some 2700 years.

In Fig. 1 the results of the isotopic analyses are plotted against age as given by the annual rings, an abscission having been made on the abscissa at A.D. 500 so that the span from A.D. 500 to 1700 is continued below the earlier span with a repeated ordinate. The units on the ordinate are the δ values used previously (*1*) for the C^{13} enrichment with respect to a standard working gas expressed in per mil, that is,

$$\delta\ (0/00) = \left(\frac{R_{sample} - R_{std.}}{R_{std.}}\right) 1000,$$

where R is the ratio C^{13}/C^{12}. The standard has the isotopic composition of the average marine limestone (*1*); the values in Fig. 1 are negative and are thus "lighter" than limestone carbon (i.e., depleted in C^{13}) by some 2 percent. The precision of measurement is ± 0.1 per mil, or about the diameter of the dots in the diagram. Thus one sees at once that significant variations in isotopic composition are present.

The major characteristic of the observed isotopic

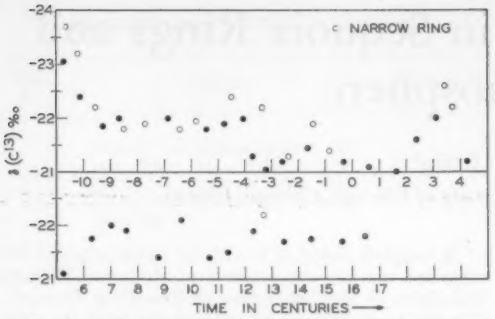

FIG. 1. Variation of carbon-13 concentration in annual rings of *Sequoia gigantea* from 1072 B.C. to A.D. 1649. Ordinal values represent C^{13} enrichment in per mil with respect to an arbitrary standard which has the isotopic composition of average marine limestone.

variations is the fact that the variations are extremely small and show no systematic trend with time. This observation does not hold for the first 150 years of growth where a steady increase in C^{13} concentration is observed; this is the period of most rapid growth, and it is an interesting question whether a growth effect or a real atmospheric effect operated at this point. The problem is particularly tantalizing since apparently there are no available older sequoias to extend the record substantially back in time; however, some insight may be gained by a study of contemporaneous and younger trees. For the rest of the time span the variations show a rather steady rise and fall over periods of several hundred years; the period from 928 to 477 B.C. shows a constant isotopic composition within the precision of analysis ($\delta = -21.9$ per mil), and the last 300 years of the curve, A.D. 1344 to 1649, is also constant at -21.7 per mil. Thus there is no steady trend with time and the probability appears strong that the mean isotopic composition of the atmospheric carbon was essentially constant over this 2500-year span, and further, that the fractionation factor does not change systematically with the age of the tree.

Interpretation of the fine structure of the curve is limited by our lack of knowledge of the exact mechanism by which plants fractionate the isotopes. The data indicate that very small radial inhomogeneities in isotopic composition are well preserved, though a certain amount of "smoothing" during the years immediately subsequent to the growth of each ring cannot be definitely excluded. The overall preservation of the isotopic record in sequoia has been definitely established by radiocarbon dating (*5*). There appears to be no correlation of isotopic composition with the width of the rings; the ring widths were measured prior to the analyses and a plot of these widths against age shows no general similarity to Fig. 1. The unfilled circles in Fig. 1 represent rings which were of excessively narrow width compared with the general average of rings in the vicinity; there appears to be some tendency for these narrow rings to be relatively depleted in C^{13} when the slope is changing, but in the period from 900 to 500 B.C. there are large variations in the width of the analyzed rings while the isotopic composition is constant. Figure 1 also shows no overall similarities to the graphs of average sequoia ring widths against time given by the various workers in this field (*2–4, 6–9*).

Variations in the thickness of tree rings are generally interpreted as reflections of the total precipitation during the year or years preceding the growth of each ring (*4, 7, 9*), though temperature and solar radiation have also been stated to be important (*8*), especially in high latitudes (*10*). However, a relationship of isotopic composition with precipitation cannot be definitely excluded on these grounds, since it has been recognized that sequoia annual growth in many individual trees shows a relatively poor relationship with rainfall compared to certain other conifers of drier regions. Douglass has shown that sequoias growing on ridges or steep slopes may show a significant relationship to rainfall, but that the ring records of sequoias in basin sites are individually quite unreliable as rain gages, especially in the early centuries of growth; the specimen D-22 here analyzed is of this basin type (*3*). Accordingly, Dr. Schulman undertook an analysis of the data in terms of other and better growth indices of the climatic nature of the intervals near the analyzed rings, and reported as follows: "The data on C^{13} composition seem to have no apparent relation to the inferred rainfall for corresponding dates, as judged by the rain-sensitive growth indices of nearby regions for the last five centuries and more distant regions for fifteen earlier centuries. I examined your C^{13} dates not only for the corresponding estimated rainfall departures but also with reference to the inferred general maxima, minima, and trends in rainfall near these dates. However, my analysis was necessarily quite approximate."

The isotopic composition of atmospheric carbon dioxide is regulated by the exchange reaction with the 60 times greater reservoir of carbon in the sea; the temperature coefficient of the exchange equilibrium constant is 6° C for a 1 per mil variation in the enrichment factor using Urey's calculation based on empirical data, and must be greater, probably about 8° C for 1 per mil because of the newer corrected values for the isotopic composition of atmospheric carbon dioxide (*1*). This change must be reflected almost entirely in the atmosphere because of the proportions of the phases. Thus, to account for the fluctuations in Fig. 1, of the order of 1 per mil, by changes in mean temperature, variations in temperature of the order of magnitude of those estimated to have been the maximum variations between glacial and inter-glacial periods are required (*11*).

The variations shown in Fig. 1 show a rough periodicity of the order of 400 years, thus precluding any direct relationship with the mixing rate of the atmosphere. One may ask if they can be assigned to the rate of isotopic exchange between ocean and atmosphere; that is, the variations might be postulated to

reflect the addition to the atmosphere of carbon dioxide of different isotopic composition produced from volcanic and hot spring sources. This added carbon dioxide will generally be a mixture in varying proportions of carbon dioxide from limestone and juvenile carbon dioxide. The composition of juvenile carbon dioxide is not exactly known but consideration of the observed distribution of the carbon isotopes (*1*) and recent work on the isotopic composition of carbon from various thermal areas (unpublished) indicate that its composition lies somewhere between that of limestone (0 per mil) and igneous rock carbon (−25 per mil). Moreover, the observed variations in *Sequoia* appear to be generally in the direction of becoming enriched in C^{13} with respect to the two intervals of constant isotopic composition; thus we obtain the minimum amount of carbon dioxide that must be added to the atmosphere by assuming that it is purely derived from limestone with a δ value of 0 per mil. The atmospheric carbon dioxide is about −7 per mil (*1*), and thus one must add an amount of carbon dioxide equal to at least 15 percent of the amount in the atmosphere to enrich the atmosphere in C^{13} by 1 per mil; this amount corresponds to 10^{12} metric tons of limestone or a layer 20 km square and 1 km thick which must be decomposed in a time of the order of 200 years. Mixing dead carbon dioxide into the atmosphere should of course dilute the radiocarbon concentration and thus decrease the specific activity of material living at this time. Consideration of the radiocarbon dates obtained from samples of known age, as compiled by W. F. Libby from his work and that of others, shows that samples which grew at various intervals within the span from 1000 to 100 B.C., where the sequoia curve indicates a change in C^{13} concentration of 1 per mil, fit the calculated curve of specific activity against time as well as other known samples with no indications of deviations of the order of 15 percent.

From the above considerations of the temperature coefficient of the isotopic exchange reaction and the necessary amount of material which must be mixed into the atmosphere, it would seem to be improbable that the sequoia variations can represent world-wide changes in the mean isotopic composition of the atmosphere; rather, they may merely reflect irregular variation of the isotopic fractionation factor of the tree. The natural fractionation of the carbon isotopes by plants has been discussed in detail elsewhere (*12*); it was shown in this discussion that the environmental "cyclic enrichment process" postulated by Wickman (*13*) cannot be operative in nature and that the depletion in C^{13} of terrestrial plants is most probably a result of the compounding of several fractionation stages within the plant itself. Consideration of the isotopic data indicated that gaseous diffusion of carbon dioxide is probably not a rate controlling step in the assimilation sequence and that the fractionation is thus produced in one or more equilibrium stages, depending on the reversibility of the carboxylation reaction, and in the first kinetic stage after the last equilibrium reservoir of assimilated carbon, plus any other stages in which dismutation of a carbon carrier and fractional feedback occur. Isotopic selection in the respiratory process can superimpose another fractionation factor on that attained in the assimilation process, and thus the total enrichment factor may be expected to vary considerably in different plants, not only intrinsically but also because of variations in the ratio of photosynthesis to respiration which determines the net fraction of carbon retained by the plant. It is therefore not unreasonable to expect that isotopic variations of the order of magnitude of those found in *Sequoia* can result from changes in external conditions which may affect the fractionation factor attained in the assimilation process, for example by the temperature coefficient of equilibrium stage fractionation or by causing different steps to become fractionation controlling, and which may affect the overall enrichment by producing variations in the ratio of photosynthesis to respiration. Such effects could be caused by changes in light intensity, temperature, precipitation, etc., and it is not, a priori, necessary that the isotopic effects should be correlated with variations in the width of the annual rings since the individual effects of changing external factors may be weighted quite differently in the two cases.

It is clear that many more trees and more closely spaced rings from individual trees must be analyzed before any definite conclusions concerning the fine structure of such variations can be reached. The data indicate, however, that the isotopic composition of the atmospheric carbon was constant to at least 1 per mil during the 2500-year interval from 900 B.C. to A.D. 1600 with a change in mean composition probably less than 0.2 per mil. The considerations discussed above indicate that even the 1 per mil irregular variations in *Sequoia* are more probably due to the effects of varying external conditions on the assimilation and respiratory processes of the tree rather than to atmospheric changes. Future work on the cause of such variations should be worthwhile; nevertheless it should be stressed that such variations, while real enough, are of extremely small magnitude compared to the 4.5 percent variation encountered in nature. It is this aspect which is of considerable interest with respect to the application of what may be called "natural" isotopic tracer and dilution techniques to geochemical problems, and which will be discussed in this respect elsewhere.

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Erwin Brand: 1891-1953

Orr E. Reynolds and Jesse P. Greenstein

WITH the death of Erwin Brand on July 12, 1953, American biochemistry lost one of its most colorful and creative personalities. He was born in Berlin, Germany, on June 17, 1891, was graduated from the Realgymnasium in Berlin in 1909. He subsequently studied chemistry and medicine at the universities of Munich, Greifswald, and Berlin. Brand was among the last students of Emil Fischer, and after the latter's death, he continued his studies with Max Bergmann, and obtained his Ph.D. at Berlin in 1920, with his thesis on glyceride synthesis. When Bergmann was appointed director of the Kaiser-Wilhelm Institut für Lederforschung in Dresden in 1920, Brand accompanied him and assisted in the establishment of the new institute, which was housed in a converted mansion in the Schweizerviertel part of the Altstadt. Brand's skill in the organization and establishment of the new institute shortly after the close of a disastrous war and in the midst of near economic chaos revealed those constructive talents that he was to display much later, in a distant land, and in the last years of his life. He remained with Bergmann in Dresden for two years, until 1922. During this period he was associated with the brilliant initial studies on oxazolidines and the phenomena of acyl transfer from nitrogen to oxygen in amino alcohols.

The second phase of Brand's life began with his emigration to the United States in 1922. From 1923 to 1929 he was employed in the Laboratory Division of the Montefiore Hospital in New York City. This period of his life was primarily one of adjustment to a new country, but toward its close he began the study of cystinuria which, together with studies on creatine and glycine metabolism in muscular and neuromuscular diseases, was to engross much of his interest during the third phase of his career at the New York State Psychiatric Institute from 1929 to 1937, and at Columbia University from 1931 onward. With Cahill and Harris, Brand showed in 1935 that the ingestion by a cystinuric individual of cysteine or methionine leads to excretion in the urine of extra cystine, whereas administered cystine and glutathione are almost completely oxidized to inorganic sulfate. The conclusions drawn from this brilliant study anticipated much of the later developments in the intermediary metabolism of the sulfur-containing amino acids.

Since in the normal course of events the sulfur-containing amino acids metabolized by the body originate from dietary protein, Brand turned his attention to the study of proteins of different sulfur content. In part, this necessitated the development of accurate methods of analysis for methionine and cystine (or cysteine) in the hydrolyzed proteins, a project which was carried out with Miss Kassell's assistance, and which was further widened in scope to include methods of analysis of all other amino acids present in the protein hydrolysates. Thus, Brand was prepared for what might be termed the fourth stage in his career. When World War II broke out, he was associated with the characterization of the plasma proteins carried out by Edwin J. Cohn and his staff at Harvard University. Under a contract between OSRD and Columbia University, Brand embarked upon a program of complete amino acid analyses of plasma and other proteins, attaining in his extraordinary studies on β-lactoglobulin what might well be the first complete analysis of a protein in terms of its amino acid content.

During this stage (roughly from 1941 to 1946) a new aspect of Brand's career began to emerge—his interest in chemical societies by which most biochemists outside of his own specialized fields of interest were best to know him. He served as councillor of the American Chemical Society, representing the New York Section from 1943 to 1946, and from 1941 to 1946 he was Secretary of the Division of Biological Chemistry of the American Chemical Society. Thus as Brand entered the fifth stage of his career, he did so in two capacities, as a builder of an organization, and as an investigator of polypeptide chemistry. In the last ten years of his life, he threw all his energies into both activities with youthful vigor and enthusiasm. With the financial assistance of the Office of Naval Research and of the National Institutes of Health, he and his younger collaborators, Erlanger, Polatnick, Sachs, and others, turned their laboratory into a small polypeptide factory, building upon a well-conceived plan and with beautiful experimental technics what is probably the most unique collection of optically active polypeptides made since Emil Fischer's time. These were subjected to optical rotation studies, and demonstrated essentially the additive function of the asymmetric carbon atoms of the constituent amino acid residues, in much the same fashion as Claude Hudson had shown many years before to be true of sugars. The other phase of Brand's activities during this period was revealed in his galvanization of the Division of Biological Chemistry into one of the most active and respected units of the American Chemical Society. He served as chairman of the Division from 1946 to 1948 and as Councillor from 1948 onward. He organized the Younger Chemists International Project in 1951, to enable young chemists from nearly every nation in the free world to attend the World Chemical Conclave and to make conducted tours in the United States. For this project he labored unceasingly, obtaining generous support from several industries, ECA, the State Department, and the Ford

Foundation. He was active in the National Committee of Biochemistry, the International Committee for Biochemistry (of which he was one of the two American representatives), and the India Science Congress in Calcutta of 1952, to which he had been invited as a guest of the Indian government. It is not improbable that the burden of all these activities, both scientific and administrative, hastened his end.

It is impossible to conclude a survey of Brand's life without a few words about his complex and many-sided personality. To many he appeared to be cantankerous, blunt, and forbidding. That despite these impressions he should have accomplished so much of value is a tribute to the very patent sincerity and unselfishness with which he fought for his causes. He was a creative and constructive force, and such people are usually angular and driven by a remorseless energy. Yet he frequently exhibited unexpected acts of personal kindness and generosity, and he was loyal to the core. Brand was, quite simply, a man incapable of the petty arts of social duplicity, and his personality was completely transparent. One had to know him well to understand and appreciate the mixture of rigorous intellectual honesty and of personal kindness which were his characteristics. He died quietly and in his sleep, a peaceful ending to a vigorous and notable career. His wife, Florence Brand, whom he married in 1932, and who is also a biochemist by training, survives him.

News and Notes

Report on the Eighth Pacific Science Congress and Fourth Far-Eastern Prehistory Congress[1]

THE Eighth Pacific Science Congress, which met in Manila, November 16–28, 1953, was an outstanding success both in terms of attendance and in scientific accomplishments. The Congress, which was held under the auspices of the Republic of the Philippines and the National Research Council of the Philippines, met jointly with the Fourth Far-Eastern Prehistory Congress, on invitation of President Elpidio Quirino, at the University of the Philippines in Quezon City. Originally, the Seventh Congress had been scheduled in Manila in 1943 but the war interfered. The rebuilding of Manila, recently completed, made it possible to renew the invitation originally extended by the late President Manuel L. Quezon.

Over 700 delegates representing some 30 countries and 20 fields of specialized scientific knowledge gathered for the opening sessions, the largest group of scientists ever assembled in the Pacific region. For the first time, also, there were large numbers of Asian scientists, an indication that the newly independent countries of east and south Asia recognize the value of science in meeting their problems. There were large delegations from Australia, the Republic of China, Hawaii, Indonesia, Japan, New Zealand, Thailand, the Philippines, and the United States. The U.S. delegation, led by Knowles A. Ryerson, consisted of 25 delegates from the National Research Council, including the 10 official U.S. delegates, and some 70 additional participants from research institutions, universities, governmental agencies, the military services, and the Trust Territory. This large U.S. participation was made possible through the efforts of Harold J. Coolidge, with the cooperation of various private foundations and government departments and agencies.

The scientific accomplishments consist of the papers which were presented and discussed over the two-week period and the intangible influences of scientists on one another and on the community in which they met. The objectives of the Pacific Science Association, the parent body responsible for the congresses, are "to initiate and promote cooperation in the study of scientific problems relating to the Pacific region, more particularly those affecting the prosperity and well-being of Pacific peoples; and to strengthen the bonds of peace among Pacific peoples by promoting a feeling of brotherhood among the scientists of all the Pacific countries."

The Congress opened with a plenary session in which acting foreign secretary Felino Neri welcomed the delegates on behalf of the Philippine government, and Vidal A. Tan, president of the University of the Philippines and of the Eighth Pacific Science Congress, addressed the audience of over 6000 delegates and guests on "The Role of Man in Science." The heads of foreign delegations made brief remarks before the delegates met in some 20 groups for the discussion of scientific problems. The organizing committee had arranged a program stressing symposia which cut across various fields, as well as divisional discussions, and had interspersed public lectures by outstanding scientists and excursions to various points of interest. A major feature was the invitation of the National Power Corporation to hold a symposium on conservation planning at the site of the Ambuklao power dam project on the Agno River near Baguio.

Physical science papers were grouped under Geology and Geophysics, Meteorology, and Oceanography, under the respective chairmanships of Jose M. Feliciano, Casimiro del Rosario, and V. Villadollid.

In the sessions of Geology and Geophysics, papers were presented in 9 symposia that covered such Pacific

[1] The writer is indebted to K. O. Emery, Geology Department, University of Southern California, E. W. Gifford, Department of Anthropology, University of California, and H. O. Beyer, University of the Philippines, for information and notes on various activities included below.

Ocean fields as Volcanology, Geologic Mapping, Geologic History, Mineral Deposits, Mining Geology, Plutonics, Basement Complex, Seismology, and Salient Problems. Seventy titles were listed in the program. About one-quarter of these were read only by title or by an alternate speaker in the author's absence, and an additional 5 or 10 papers, which arrived too late to be scheduled, were fitted into the program. Judging from the amount of discussion, the most popular symposia were those on Geological Mapping and Salient Problems.

In Oceanography, 85 papers were presented in 6 symposia entitled Exploitation and Utilization of Marine Products, Marine Provinces, General Circulation, Pondfish Culture, Coral Atolls, and Productivity in Temperate and Tropical Waters. Characteristic of the Oceanography sessions were the joint participations with other groups such as Meteorology, Geology, Nutrition, Zoology, Botany, and Soil Science. The inclusion of papers having such general interest led to audience reactions that were limited only by lack of time, especially for the symposia on Coral Reefs and Biogeography.

Meteorology sessions were mostly organized in informal discussions. Nine such meetings were arranged around the following subjects: Current Research Projects of Pacific Meteorology, Research Needs and Techniques, General Meteorology, Problems of Forecasting, Cloud Physics, Typhoons, Easterly Waves and Intertropical Convergence, Microseismology, and Climatology. The informal presentations aroused more interest and audience participation than would formal papers, and it is recommended that the method be considered for subsequent meetings of other groups at future Pacific Science Congresses.

There were excursions to Tagaytay Ridge overlooking Taal Volcano and Typhoon Cora, which the meteorologists followed with great interest. Through the aid of UNESCO, a preliminary meeting of oceanographers was held to formulate plans for the organization of an oceanographic research body to develop and coordinate research in the Indo-Pacific region. Public lectures were given by Anton Fr. Bruun, on "Life and Life Conditions of the Deepest Deep-Sea"; Gordon A. MacDonald on "Hawaiian Volcanoes"; and Pierre Auger, on "Cosmic Rays."

The biological science papers were subdivided among a number of categories that included Oceanography (in part), Zoology, Botany, Soil Resources, Forestry, Agriculture, Animal Improvement, Crop Improvement, Public Health, Nutrition, Pacific Conservation, and Management and Utilization of Natural Resources, in addition to special sessions devoted to Nutritional Enrichment of Rice, Fuels and Lubricants, and Problems of the Coconut Industry. The bulk of the papers and symposia were concentrated in this group and there was a strong emphasis on applied science, as well as on new findings.

The Zoology Section centered its attention on Pacific entomology under the chairmanship of L. B. Uichanco, and emphasized ecological studies, classification, and technics of control. Botany, with Eduardo Quisumbing as chairman, held symposia on Vegetation Provinces, Floristic Trends, Alien Plants, Ethnobotany in the Pacific (with anthropology), and Medicinal Plants. Forestry, under the chairmanship of Florencio Tamesis, held a separate series of sessions in which emphasis was placed on the management and utilization of forests and forest products, and on the status of the protection of rare and vanishing species of plants and animals.

The program in Agriculture, under the chairmanship of Jose S. Camus, centered around a series of joint symposia with related sections and a symposium on Rice, and it included trips to the Quezon Coconut Experiment Station and to the College of Agriculture at Los Baños. Special attention was given in Soil Resources to the symposia on Land Classification and on Soil Classification in the Pacific Area; the chairman was Marcos M. Alicante. A large number of symposia were scheduled on animal and crop improvement and on animal and plant diseases.

The Public Health Section, under the chairmanship of Hilario Lara, held a series of panel discussions on: Problems of Rural Health and Disease; Health Education and Training; and specific problems such as schistosomiasis, malaria, filariasis, yaws, and other disease. A successful field trip involved a visit to Leyte to see the Schistosomiasis Control Pilot Project. A joint symposium was held on Rats and Rat Control and its importance to public health and agriculture. Special symposia were also arranged in nutritional problems of the Pacific Area and on the nutritional improvement of rice with special reference to enrichment and parboiling. In this meeting the Bataan Rice Enrichment Experiment to combat beriberi, aided by grants from the Williams-Waterman Fund, aroused great interest.

A number of public lectures were given relating to these sections, including: "Cultivated Plants from Kebun Raya, Indonesia," by C. G. G. J. Van Steenis; "Development of the FOA—PHILCUSA—Assisted Public Health Program in the Philippines," by Juan Salcedo, Jr.; "Polymorphism in Relation to Evolution," by Julian Huxley; "Environmental Control, Ecological Divergence, and Physiological Rhythm among Oceanic Birds," by Robert C. Murphy; and "The Biology of Oyster, Pearl, and Mother of Pearl of the Tuomotus," (in French), by Gilbert Ranson.

The Social Science Section, under the chairmanship of Amando M. Dalisay, held a series of important symposia devoted to the problems of land tenure, population, education, and ethnic interrelationships and administration in the Pacific region. It participated in a number of joint symposia on Economic and Power Resources in the Pacific Area, Rural Community Organization, and The Role of Social Sciences and Applied Anthropology in the welfare of Pacific Peoples. The great amount of interest in these sessions, particularly on population, land tenure, and social sciences in relation to welfare, should stimulate the development of social science in the Philip-

pines very considerably, particularly at the University of the Philippines where a Social Science Research Center is being organized with assistance from the Rockefeller Foundation.

The Fourth Far-Eastern Prehistory Congress, with H. O. Beyer as chairman, included a section on Anthropology, and held parallel sessions in Archaeology and Cultural Anthropology, the latter included Linguistics. The Prehistory Congress, originally begun as an offshoot of the Fourth Pacific Science Congress held in Batavia in 1929, has held 3 independent meetings. This present meeting was the largest and most successful, and was attended by some 63 archaeologists and anthropologists from 19 countries.

The Prehistory Section, with some 36 members, discussed the developments in the past 15 years in East Asian and Oceanic archaeology. The discovery of Paleolithic sites in the Celebes, Timor, and Japan, the clarification of the relations of painted pottery and black wares in China, the discovery of new remains of fossil animals in the Philippines and Celebes, the discovery of the ancient site of Funan in Indochina by aerial photography and the clarification of Oceanic cultural movements are some of the major achievements reported on.

The section on Cultural Anthropology and Linguistics had an unusually interesting program that covered field research on social organization and religion in Japan, the Ryukyus, Formosa, the Philippines, Borneo, Australia, and Micronesia, and that reported on the findings of modern linguistic research in the Philippines. The linguistic papers had an enthusiastic reception and resulted in an informal organization to coordinate and facilitate research on Philippine languages in particular, and Malayo-Polynesian languages in general.

In addition to archaeological tours to nearby sites, a series of post-Congress tours was organized to visit the Ifugao rice terraces at Banawe and various native groups in the Mountain Province. Several public lectures were given: "The Discovery and Study of the Earliest Known Human Fossils and their Place in the History of Man's Development," by G. H. R. von Koenigswald, one of the distinguished guests of the Congress; "The History and Characteristics of the Stone-Walled Rice Terraces of Luzon," by H. O. Beyer; "Islands and Men—Malayo-Polynesian Peoples of Oceania," by Alexander Spoehr; and "The Importance of the Anyang Discoveries on Prefacing Known Chinese History with a New Chapter," by Li Chi.

One full day was devoted to museums and their problems, under the chairmanship of Eduardo Quisumbing. The almost total destruction of the Bureau of Science during the war and the loss of almost all the botanical, zoological, geological, and anthropological collections housed in the Bureau led to efforts to secure a new museum building and to bring about the rehabilitation of the collections. The Congress passed a resolution strongly urging the government to give priority to the construction of a national museum.

A day was devoted to the problems of international organizations, under the chairmanship of Manuel L. Carreon. Representatives of UNESCO, the South Pacific Commission, WHO, FAO, and other agencies reported on their activities and interests.

One of the highlights was the visit of a group of some 20 scientists, under the leadership of Julian Huxley, to the Ambuklao Power Dam Project. The symposium on Conservation Planning in Relation to Power Developments held at Baguio, jointly sponsored by the sections on Pacific Conservation and the Management and Utilization of National Resources, reported that it was favorably impressed by the plans which had been developed by the N.P.C. for power production, resettlement of displaced persons, and protection of natural resources.

Another highlight was the first color film of the Kouprey (a recently discovered new form of primitive wild cattle [Novibos] in northern Cambodia) taken by Charles Wharton and presented by Harold J. Coolidge, who raised this animal from a sub-species to a new genus in 1940. The Cambodian government has been requested to protect this new and exceedingly important find. An added attraction was the showing of a documentary film of native life on the coral atoll of Kapingamarangi taken by Kenneth Emory and the late Sir Peter Buck, and with a commentary by E. H. Bryan, Jr.

The Pacific Science Council received invitations for the Ninth Pacific Science Congress from Thailand, Vietnam, Indonesia, and Hong Kong (in itself a measure of the great interest in science in the Far East), and elected to meet in Bangkok, Thailand, in January, 1958.

The Far-Eastern Prehistory Congress, in the meantime, had established a permanent standing committee with B. P. Groslier as chairman and Roger Duff as secretary, and had tentatively agreed to meet a week ahead of the Ninth Pacific Science Congress so that its members might participate more fully in both sessions. H. O. Beyer was elected honorary chairman of the Prehistory Congress standing committee in honor of his work in organizing the present Congress.

The closing plenary session was devoted to business matters and reports, under the chairmanship of Vidal A. Tan. Some forty resolutions were adopted by the Congress, including resolutions to set up a standing committee on Pacific Botany, to conserve vanishing species, to make special studies of nutrition in Pacific countries, to improve meteorological studies, to establish an oceanographic society, and to increase the participation of South American countries in the next Congress. The establishment of a permanent Secretariat for the Pacific Science Council was approved. This secretariat is to be supported by participating countries, and located at the Bishop Museum in Honolulu under the secretaryship of Brenda Bishop.

The smooth operation of the Eighth Pacific Science Congress was largely the result of the work of Patrocinio Valenzuela, secretary-general of the Congress, and his able staff, assisted by the members of the Or-

ganizing Committee, who were the chairmen of the various sections, and the Secretariat of the Pacific Science Council. The proceedings will be published in several volumes in the near future.

The visiting scientists will remember Philippine hospitality. The excursions to Bataan and to Los Baños furnished welcome interludes in the program and gave scientists of different sections a chance to compare notes and get acquainted. The official hospitality, evidenced in President Quirino's cocktail party, in the dinners given by the National Research Council, the Philippine Columbian Club, and President Tan, was matched by the private hospitality of Philippine scientists and scholars. The newspapers said that the visitors had made the Philippines "science minded," and we hope it is true. We learned a great deal about the Philippines and will welcome an invitation to return.

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Science News

At an estimated cost of $20,000,000, the U.S. will build a **25-billion-volt atom smasher** at Brookhaven National Laboratory. The machine, known as an alternating gradient synchrotron, will use the strong-focusing idea worked out nearly two years ago. The strong focus is developed by using many small magnet sections, rather than the larger ones now common, to focus the whirling atomic particles. The new accelerator will develop more than eight times as much energy as Brookhaven's present cosmotron, which has operated at 2.3 billion electron volts and is expected some day to reach 3 bev, at the very lowest level of cosmic ray energies.

The bevatron under construction at the University of California's Radiation Laboratory, Berkeley, is expected to accelerate particles into the 5- to 7-bev range. A European group known as the Council for European Research, Nuclear, or CERN, is making plans for a 30-bev accelerator, also using the strong focusing principle.

The latest step taken by the American Psychiatric Association to raise standards of treatment and care of mentally sick persons is to set up a committee to certify "qualified mental hospital administrators." The committee will conduct examinations periodically and issue qualification certificates to successful applicants. The object is to help insure that the chief executives of mental hospitals shall not only be physicians adequately trained in psychiatry, but that they shall also be skilled in business and personnel management, community relations, budget control, procurement, and other essential administrative techniques.

Ever since 1844, the Association has maintained that the chief executives of mental hospitals must be physicians specialized in psychiatry. The Association regards as unsound, proposals to separate "administrative" from "medical" reponsibility in the hospital, with corollary suggestions that doctors should confine themselves to medical matters only. It believes that all mental hospital operations bear a direct relation to the progress of a patient, and accordingly that only a physician may assume total responsibility for them.

A new **method for studying fluid flow** has been devised by S. Koncar-Djurdjevic of the Institute of Inorganic Technology, Belgrade, Yugoslavia. Flow is investigated by placing objects coated with silica gel in a water stream containing a very small amount of blue dye. The amount of dye that coats different parts of the object's surface is a measure of how the water passed over it and how it forms eddies. This adsorption technique is said to have several advantages over those methods now in use. It gives permanent records without need for photography, it is simple, and it can be applied to large surfaces.

At a recent conference on radio astronomy sponsored by the National Science Foundation, the Carnegie Institution of Washington, and the California Institute of Technology, J. D. Kraus reported that the positions of about a dozen **radio "stars"** have been confirmed with the new radio telescope at Ohio State University. The instrument, twice as large as its predecessor, has 96 antenna, each in the form of a helix. It was first put in operation on Jan. 1.

Element 43 in the periodic table, **technetium**, which is found in the debris of atomic bombs, becomes superconductive at the relatively high temperature of 11.2° on the absolute scale. The discovery was made by J. G. Daunt of Ohio State University and J. W. Cobble, formerly at Oak Ridge National Laboratory and now at the University of California's Radiation Laboratory.

Within six to nine months the largest telescope in the **U. S. Naval Observatory** in Washington, D.C., will be moved to Flagstaff, Ariz. Sky brightness over Washington and smog conditions now give the instrument low operating efficiency. It is proposed to staff the new laboratory with two or three permanent civilian employees.

Scientists in the News

Pier A. Abetti, an employee of the General Electric Company and an Italian-born citizen who has been in this country only seven years, has been selected as the nation's outstanding young electrical engineer for 1953 by Eta Kappa Nu Association. He was honored for "his original approach to power transformer design through the creation of unique electro-magnetic models and his exceptional civic and cultural attainments." Eta Kappa Nu also awarded honorable mentions to **John E. Jacobs** of the General Electric Company, and **Adam G. Kegel**, an engineer in the Air Arms Division of the Westinghouse Electric Corp., Baltimore.

Herbert K. Abrams, medical director of Union Health Service, Inc., Chicago, has been appointed clinical assistant professor of public health at the University of Illinois College of Medicine.

Bernard Belleau has joined the staff of the research department of Reed and Carnrick, Jersey City. His work in organic syntheses will be directed towards the development of new chemotherapeutics. Dr. Belleau has previously been connected with the Case Institute of Technology, the Sloan-Kettering Institute, and Laval University in Quebec.

Rear Admiral Calvin M. Bolster, USN, who has served as Chief of Naval Research since August, 1951, retired on January 1 after 37½ years of active service. Graduated from the U.S. Naval Academy in 1919, he attended the Post Graduate School at Annapolis, and then the Massachusetts Institute of Technology where he was awarded an M.S. degree in naval architecture in 1922. He later studied at the California Institute of Technology and in 1936 earned an M.S. degree in aeronautical engineering.

Admiral Bolster has had broad experience in naval research and development work throughout his career, and worked in such varied fields as helium repurification, operation of airplanes from airships, airplane and helicopter development, aircraft carrier design, and rocket and jet propulsion. As Chief of Naval Research, Admiral Bolster has been the principal liaison officer between the Navy Department and scientists throughout the country. With his extensive background and broad personal understanding of research problems, he has been responsible for increasing and strengthening the interest of top civilian scientists in undertaking research to meet the needs of the Navy.

For his war work, Admiral Bolster was awarded the Legion of Merit and was made Honorary Commander of the Military Order of the British Empire by King George VI. In 1949 he received the American Rocket Society Gold Medal Award for rocket research and the National Air Council Annual Award in 1950 for "Outstanding Work in Aeronautical Research and Development." Admiral Bolster plans to join the research organization of the General Tire and Rubber Company, Akron, in an administrative capacity.

The 26th award of the AAAS $1000 prize, now known as the Newcomb Cleveland Prize, was made to **Barry Commoner,** professor of plant physiology at the Henry Shaw School of Botany, Washington University, St. Louis. The prize is awarded at the annual meeting of the Association to the author of a paper that has been presented on a regular program and that describes an outstanding contribution to science.

Dr. Commoner's paper, entitled "Studies on the Biosynthesis of Tobacco Virus," reported the results of experiments utilizing isotopic nitrogen as a tracer to determine the steps in the production of virus in a cell. By detailed quantitative comparisons of the biochemical processes in otherwise identical pieces of infected and uninfected tobacco leaf, it was possible to sort out those specific reactions that are linked to the reproduction of the virus.

The Prize Committee for the 120th Meeting of the AAAS included: John R. Dunning, Columbia University, chairman; Francis O. Schmitt, Massachusetts Institute of Technology; Laurence H. Snyder, University of Oklahoma; Frederick J. Stare, Harvard School of Public Health; and George B. Wislocki, Harvard School of Medicine.

At the 40th annual meeting of the Chemical Specialties Manufacturers Association, **F. B. LaForge** and **Milton S. Schechter** received the 2nd annual Achievement Award for their work on insecticides as scientists with the U.S. Department of Agriculture. They synthesized Allethrin, one of the active principles of pyrethrum. They have also made major contributions to the development of other important synthetic organic chemical insecticides.

The 9th Theobald Smith Award in Medical Sciences, established in 1936 by Eli Lilly and Company and consisting of $1000 and a bronze medal, was awarded to **Irving M. London** of the College of Physicians and Surgeons, Columbia University, during a session of Section N at the 120th Meeting of the AAAS in Boston, Dec. 28.

Dr. London received the award for his significant contributions in the fields of porphyrin, cholesterol, and protein metabolism. He studied the life span of the red blood cell in normal and pathologic states such as sickle anemia, polycythemia vera, and pernicious anemia and, using isotopic tracers, he developed a technique for observing antibody formation in surviving tissue. This provides not only a method for studying the capacity of individual tissues to form antibodies, but also a controlled system for the study of protein synthesis *in vitro*.

The 18th William H. Walker Award, granted annually by the American Institute of Chemical Engineers for distinguished contribution to chemical engineering literature, has been presented to **William Robert Marshall, Jr.,** professor of chemical engineering and associate dean of the College of Engineering, University of Wisconsin. Prof. Marshall received the award in recognition of his publication record over the years, and particularly in recognition of his contribution of nine papers to *Chemical Engineering Progress* during the period 1950–52. The papers cover various aspects of the field of drying.

Albert Schweitzer is erecting new leper colony buildings at Lambarene in Gabon, French Equatorial Africa, with the $33,000 that he received as a Nobel Prize winner. Dr. Schweitzer founded his hospital in Lambarene in 1913. It has since expanded to 40 wood and corrugated iron buildings, housing 500 patients and serving scores of jungle villages. The hospital is simple and patients live much as they do in their

homes. "The work is more desperately needed now than when I came," Dr. Schweitzer said recently.

Arne J. Suomela, who has been Oregon State Director of Fisheries since 1945, has been appointed Assistant Director of the Fish and Wildlife Service. Mr. Suomela is an authority on salmon fisheries and has done extensive research in Alaska and the Pacific Northwest.

James L. Thomas, former chief of the Resistance Measurement Section of the National Bureau of Standards, has been made chief of the newly organized Resistance and Reactance Section of the Bureau's Electricity Division. The new section is concerned with precision resistance, capacitance, and inductance measurements. Dr. Thomas has been with NBS since 1927 and has made many contributions to the field of electrical measurements. He developed the special type of precision standard used by most laboratories for maintaining the unit of electrical resistance.

Alexander R. Troiano has been named head of the Department of Metallurgy at Case Institute of Technology. He has been serving as acting head since the death of Prof. Kenneth H. Donaldson in September.

At the 13th annual meeting of the Cleveland Health Museum's National Advisory Council, held during the American Public Health Association convention, **Clair Elsmere Turner** received the 1953 Elisabeth S. Prentiss National Award in Health Education. The citation read: "A True Professor, Master Architect of School and Adult Health Education, Respected Author, World-Wide Lecturer and Consultant." Dr. Turner, professor emeritus of public health of Massachusetts Institute of Technology, has been assistant to the president of the National Foundation for Infantile Paralysis since 1946. He has also been health education consultant with the World Health Organization for four years.

Thomas H. Vaughn recently resigned from the Wyandotte Chemicals Corporation to accept appointment as vice president in charge of research and development for the Colgate-Palmolive Company.

Felix A. Vening-Meinesz, a professor of geodesy and geophysics at the universities of Utrecht and Delft, The Netherlands, is now serving as a research consultant and lecturer at Ohio State University. He will assist on the Gravity Project of the Mapping and Charting Research Laboratory. Dr. Vening-Meinesz has been occupied for the past 30 years with the study of the earth's gravity at sea by means of measurements taken in submarines. In his underwater laboratory he has traveled approximately 125,000 miles.

Charles C. Wilson, professor of education and public health at Yale University, recently received the William A. Howe Honor Award from the American School Health Association in recognition of his contribution to school health. Among many other significant activities, Dr. Wilson was a member of the Yearbook Commission of the American Association of School Administrators which wrote the book, *Health in Schools.* He is author of a number of health textbooks for school pupils.

John H. Yoe, professor of chemistry at the University of Virginia since 1919, has succeeded **Robert E. Lutz** as chairman of the department. Prof. Yoe will continue as director of the John Lee Pratt Trace Analysis Laboratory.

Grants and Fellowships

Applications for **Atomic Energy Commission fellowships** in radiological physics and industrial hygiene for 1954–55 are now being accepted by the Oak Ridge Institute of Nuclear Studies. These fellowships, designed to provide training in these two specialized fields closely related to the atomic energy program, are administered for the AEC by the Institute, and awarded to selected college graduates with degrees in basic science or engineering.

The radiological physics program provides for fellows to spend an academic year taking formal courses at one of three universities to which they may be assigned, and then to transfer to a corresponding cooperating AEC installation where they work approximately three months in applied health physics. The following three training programs are offered: University of Rochester in cooperation with Brookhaven National Laboratory; University of Washington in cooperation with the Hanford Works; Vanderbilt University in cooperation with the Oak Ridge National Laboratory.

Industrial hygiene fellows receive training at Harvard University or the University of Pittsburgh. Course work varies with the university selected and with the interests and background of the individual. Courses in public health and statistics are required for fellows, and electives include courses dealing with engineering, radiological physics, toxicology, industrial medicine, and related fields. All AEC fellowship applicants may designate their choice of institution assignment, and, when possible, assignments will be made accordingly; however, the Institute cannot guarantee compliance with the choice.

Basic stipend for AEC fellows is $1600, with an additional $350 allowed for spouse and $350 for each dependent child. Fellowship awards include payment of normal tuition and fees required by the university, and a travel allowance for the fellow (not dependents) from the place of application to his assigned university.

Additional information concerning the program may be obtained from the Fellowship Office of the University Relations Division of the Institute, P. O. Box 117, Oak Ridge, Tenn. Applications have been available from university deans and department heads since Jan. 1, as well as from the Fellowship Office. *Completed applications, supporting letters of refer-*

ence, and transcripts must reach the Institute not later than Mar. 1. Appointments will be subject to security clearance.

Fellowships for training in clinical investigation in the field of cancer in children, including chemotherapy, have been created at the **Children's Cancer Research Foundation.** Stipends range from $2400 to $5000. Application blanks may be secured from Dr. Sidney Farber, Children's Cancer Research Foundation, Boston, Mass.

In January the **Eli Lilly Company** announced the following research grants:

The Bronx Hospital. A. J. Weil, Dept. of Bacteriology. Antibiotics.

Childrens Hospital of Los Angeles. M. J. Carson, medical director. Oral suspension of erythromycin.

Columbia University. L. J. Doshay, Presbyterian Medical Center. Evaluation of Compound 08958 in Parkinsonism.

Harvard University. R. B. Woodward, Dept. of Chemistry. Strychnine synthesis.

University of Liége. E. Fredericq. Insulin studies.

University of Louisville. M. M. Best, School of Medicine. Research at Louisville General Hospital.

Oklahoma Agricultural and Mechanical College. R. J. Sirny, School of Agriculture. Possible new factors in liver products.

Polytechnic Institute of Brooklyn. H. Morawetz, Dept. of Chemistry. Synthetic polyelectrolytes.

Medical College of South Carolina. L. Banov. Effects of antibiotics on common anorectal inflammatory lesions.

Medical College of South Carolina. M. W. Beach, Dept. of Pediatrics. Effectiveness of "Ilotycin" in the treatment of diphtheria and diphtheria carrier state.

University of Washington College of Pharmacy. H. W. Youngken, Jr., Dept. of Pharmacognosy. Drug-plant investigations.

The **National Council to Combat Blindness, Inc.,** 30 W. 59 St., New York 19, has announced the launching of its fellowship program. This facet of the Council's activities was initiated under the direction of its Scientific Advisory Committee with the objective of meeting the existing shortage of trained research manpower in the field of ophthalmology and its related sciences and to encourage individuals who have training in ophthalmology or the various branches of biological, chemical and physical sciences, and investigative medicine to undertake specialized research study. Applicants are required to make their own arrangements for suitable research facilities with recognized institutions. The first three candidates awarded fellowships and the institutions at which they will work are:

State University of Iowa. E. Auerbach, University Hospitals. Retinal physiology.

Massachusetts Eye and Ear Infirmary. T. Laurent, Retina Foundation. Influence of ascorbic acid on the shape and size of the hyaluronic acid molecule in the presence of different inorganic ions and at different hydrogen ion concentration.

Eye and Ear Hospital. Pittsburgh. S. J. Solomon. Fine structure of photoreceptors.

Grants-in-aid awards approved for the fiscal year 1953–54 are as follows:

New York University. G. M. Breinin. Neotetrazolium studies in the eye, $1620.

State University of Iowa. H. M. Burian. Studies in electroretinography, $3000.

University of Pittsburgh. T. S. Danowski and L. Greenman, School of Medicine. Studies of factors affecting the development of galactose cataracts, $2500.

Presbyterian Hospital Medical Center. W. G. Everett, Institute of Ophthalmology. Mensuration of living eye by x-ray and relation of measurements to pathologic states, $1000.

Wills Eye Hospital. H. Green and I. H. Leopold. Investigation of the intermediary reactions and the enzyme systems involved in lens metabolism, $3000.

University of Chicago. A. C. Krause, School of Medicine. Toxoplasma in domestic animals, $950.

Government Hospital, Haifa, Israel. I. C. Michaelson. Factors affecting new vessel growth, particularly in the cornea, $3000.

Tulane University Medical School. J. W. Rosenthal. Genetic study of the spheroplakia, glaucoma, brachydactyliasyndrome, $400.

Cerrahpasa Hospital, Istanbul. N. Sezer. Characterization of the virus of Behcet's disease, $2000.

Indiana University. F. M. Wilson, Medical Center. Experimental study of effects of beta irradiation, $1500.

Eye and Ear Hospital, Pittsburgh. J. J. Wolken. Fine structure of photoreceptors, $1200.

Stanford University. M. Fine, School of Medicine. Inhibiting effect in serum of patients with sarcoidosis (ocular and other) upon the hemoagglutination test for tuberculosis and other agglutination reactions, $2500.

The National Muscular Dystrophy Research Foundation, Inc. has announced that those wishing to apply for moderate grants-in-aid should write to the Executive Secretaries, National Muscular Dystrophy Research Foundation, Inc., 709 Main St., Liberty, Tex. The Foundation has recently awarded the following grant:

Southwest Foundation for Research and Education. R. B. Mefferd. Individual metabolic patterns for families having a history of muscular dystrophy, $5000.

United Cerebral Palsy has made the following research grants for the year preceding Sept. 30, 1953:

University of California, Los Angeles. H. W. Magoun, School of Medicine. Factors promoting regeneration of nerve fibers in the central nervous system.

Stanford University. J. A. Anderson, School of Medicine. Effect of growth on certain physiologic and biochemical aspects of the central nervous system of monkeys.

Instituto N. de Cardiologia, Mexico City. A. Rosenbleuth. Neuro-physiology in cerebral palsy.

University of Cincinnati. G. H. Acheson, College of Medicine. Changes in ganglionic transmission resulting from section of postganglionic axons.

Columbia-Presbyterian Medical Center. H. H. Merritt. Neurophysiology of the basal ganglia, and fundamental neurological research of importance to cerebral palsy.

University of California, Los Angeles. H. W. Magoun, School of Medicine. Physiology of the cerebral cortex and basal ganglia in relation to cerebral palsy.

New England Deaconess Hospital. S. P. Hicks. Mechanism of development of malformations of the nervous system with special reference to cerebral palsy.

University of Arkansas. W. K. Jordan, School of Medicine. Nucleic acid chemistry of nervous tissues.

St. Christopher's Hospital for Children. J. B. Arey and H. Baird. Genesis and nature of cerebral palsy with a diagnostic service for neuropathologic studies in cerebral palsy.

Armed Forces Institute of Pathology. E. Gyori. Study and research on the pathology of disease in the nervous system.

University of Utah. R. W. Doty, College of Medicine. Functional reorganization of the nervous system after hemispherectomies with particular reference to the surgical treatment of CP.

Harvard University. P. I. Yakoviev, Medical School. Developmental anomalies of finer structure and fiber connections of the central nervous system in malformations of the cerebral mantle.

University of Michigan. R. Allen. Work in neurology and some basic science techniques.

Gallinger Municipal Hospital, Washington, D.C. J. F. Fazekas. Influence of traumatic head injuries and hypoxia on cerebral hemodynamics and metabolism.

University of Tennessee. J. G. Hughes. Relationship of birth injury to subsequent cerebral palsy utilizing electroencephalography through the newborn period and throughout childhood.

University of Utah. C. A. Swinyard and C. H. U. Chu.

Effect of anoxia and lead poisoning on brain water and electroshock seizure threshold.

Children's Medical Center, Boston. S. Farber. Diagnosis, research, and training of personnel in cerebral palsy.

Orthopedic Hospital, Los Angeles. R. Harrington. Breathing movements in a selected cerebral palsy population.

Children's Medical Center, Boston. B. Crothers. Natural history of cerebral palsy.

University of Rochester, Strong Memorial Hospital. R. P. Schwartz. Drug research.

University of Illinois. K. Unna, College of Medicine. Neuropharmacologic approach to the treatment of cerebral palsy.

Meetings and Elections

The **American Orthopsychiatric Association** has elected the following officers for 1954: pres., Hyman S. Lippman, St. Paul, Minn.; pres.-elect, Simon H. Tulchin, New York, N.Y.; v. pres., Jean W. MacFarlane, Berkeley, Calif.; sec., Exie E. Welsch, New York, N.Y.; treas., William S. Langford, New York, N.Y.

The University of Illinois will be host to the 62nd annual meeting of the **American Society for Engineering Education,** June 14-18. More than 2000 participants are expected. The theme of the meeting, "Evaluation of Engineering Education," will be presented by the Society's president, Dean L. E. Grinter of the University of Florida. Special sessions, sponsored jointly by various divisions of the Society, will be devoted to improvement and recognition of good teaching, presentation of prize winning papers from the Young Engineering Teachers Group, and discussion of common problems of universities, industry, and government.

The meeting will also mark the golden anniversary of America's first engineering experiment station, which was established late in 1903 at the University of Illinois. Six summer schools concerning special educational areas of engineering will be held before and after the annual meeting.

The **American Society of Human Genetics** has elected the following officers for 1954: pres., James V. Neel, Heredity Clinic, Univ. of Michigan; v. pres., Alfred F. Blakeslee, Smith College; treas., Nash Herndon, Dept. of Medical Genetics, Bowman Gray School of Medicine; sec., Sheldon C. Reed, Dight Institute for Human Genetics, Univ. of Michigan.

Lewis K. Silleox, of the New York Air Brake Co., has been elected president of the **American Society of Mechanical Engineers.** Named as regional vice presidents are: Willis F. Thompson, Westcott & Mapes, New Haven, Conn.; William G. McLean, Lafayette College, Easton, Pa.; Thompson Chandler, Carbide & Carbon Chemical Corp., South Charleston, W. Va.; Vernon A. Peterson, Elliott Co., Los Angeles, Calif.; and Clifford H. Shumaker, Southern Methodist University, Dallas, Tex.

The 6th Annual Symposium on Recent Advances in the Study of Venereal Diseases will be held at the Department of Health, Education, and Welfare, Washington, D.C., on Apr. 29–30. The sessions are open to all physicians and workers in allied professions who are interested in participating. These symposia usually draw hundreds from all parts of the country and are the occasion for exchange of the latest available information by the outstanding authorities. The topics for discussion will cover many aspects of venereal disease control, including basic and clinical research, serology, epidemiology, treatment, program operation, and professional education.

The **Arctic Branch, Alaska Division of the AAAS,** has elected the following officers: pres., Willibald Weniger, Dept. of Physics, Univ. of Alaska; v. pres., John L. Buckley, Dept. of Wildlife Management, Univ. of Alaska; sec.-treas., Galen Smith, Arctic Aeromedical Laboratory, Ladd Field, Fairbanks, Alaska.

At the Institute of Physics' **Conference on the Physics of Particle Size Analysis** to be held in Nottingham, England, from Apr. 6 to 9, the following sessions have been arranged: the motions of particles in fluids; the scattering of light by particles; the general phenomena encountered in particles size analysis; and the comparison of methods and the automatized methods of particle counting and sizing.

Preprints will be available beforehand and, together with a summary of the discussion, will in due course be issued as a supplement to the *British Journal of Applied Physics.* For further information, address the Secretary, The Institute of Physics, 47, Belgrave Square, London, S.W.1.

The **Gerontological Society** has elected the following officers for 1954: pres., Anton J. Carlson; pres.-elect, Ollie A. Randall; sec., Nathan W. Shock; treas., J. Esben Kirk.

The Netherlands Physical Society, with the support of the International Union of Pure and Applied Physics and UNESCO, will organize an **International Conference on Semiconductors** to be held at Amsterdam from June 29 to July 3. Lectures will be given by J. Bardeen, W. H. Brattain, H. B. G. Casimir, F. A. Kröger, D. Polder, M. Schön, W. Shockley, R. A. Smith, H. J. Vink, and H. Welker. Subjects to be covered will include: bulk recombination; surface conductivity, trapping, and recombination; intermetallic compounds, the band picture in polar and nonpolar semi-conductors; photoconductivity in semiconductors like PbS, PbTe, PbSe, ZnS, CdS; the application of general physical and chemical laws for the preparation of semiconductors with specific properties.

Discussions will be held in connection with the main lectures and there will be opportunity to analyze special problems during sectional meetings. Those who would like to participate in the conference or who wish to submit 15-minute communications for the sectional meetings should write promptly to the secretary, Dr. H. J. Vink, Floralaan 142, Eindhoven, Holland.

Officers of the **Michigan Academy of Science, Arts, and Letters** are: pres., I. Leo Sharfman, Dept. of Economics, Univ. of Michigan; v. pres., Robert R. Dreisbach, Dow Chemical Co., Midland, Mich.; sec., Pierre Dansereau, Dept. of Botany, Univ. of Michigan; treas., Volney H. Jones, Dept. of Anthropology, Univ. of Michigan.

Elwood L. Demmon, director of the Southeastern Forest Experiment Station, Asheville, N.C., has been elected president of the **Society of American Foresters.** Elected vice president was DeWitt Nelson, director of the California Department of Natural Resources.

The **Soil Conservation Society of America** has elected the following officers for 1954: pres., R. Y. Bailey, Soil Conservation Service, Spartanburg, S.C.; 1st v. pres., Edward H. Graham, Soil Conservation Service, Washington, D.C.; 2nd v. pres., Austin L. Patrick, Soil Conservation Service, Upper Darby, Pa.; exec.-sec., H. Wayne Pritchard, Paramount Bldg., Des Moines, Iowa; treas., J. S. Russell, *Register* and *Tribune,* Des Moines, Iowa.

The **Western Regional Meeting of the the American Academy of Optometry** will be held Apr. 10–11 at the University of California, Berkeley. Headquarters will be in the Shattuck Hotel, and reservations may be made through Dr. Darrell B. Carter, School of Optometry, University of California, Berkeley. The two-day meeting will feature papers by Academy members on physiological optics and the clinical aspects of optometry. A question and discussion period will follow each paper.

The **Western Society of Naturalists** elected the following officers for 1954: pres., Arthur C. Giese, Stanford Univ.; v. pres., Gilbert M. Smith, Stanford Univ.; treas., Ivan Pratt, Oregon State College; sec., John L. Mohr, Univ. of Southern California.

Miscellaneous

Announcement has been made of the publication of ***Optica Acta,*** a new European journal of optics. Papers of moderate length will appear in English, French, or German, with a summary in each of these languages. A manuscript should be submitted to the editor for the language in which it is written, from whom instructions to authors may also be obtained: C. G. Wynne, 52 London Lane, Bromley, Kent, England; A. Marechal, 3, boulevard Pasteur, Paris (XV°), France; and G. Franke, Laufdorfer Weg 2, Wetzlar, Germany.

The journal will appear on dates spaced according to the amount of material available for publication. Subscriptions, costing 3150 francs or the equivalent, may be sent to la Société de la Revue d'Optique, 3 boulevard Pasteur, Paris XV°, or to the national optical committees in France, Great Britain, Italy, Netherlands, and Spain that have agreed to assist. There will be a 10-percent deduction if there are more than 10 subscriptions from one committee.

The National Research Council of Canada announces the publication of a ***Canadian Journal of Microbiology,*** with R. G. E. Murray, of the Department of Bacteriology, University of Western Ontario, as editor. The *Journal* will be issued every two months commencing in August. It will publish papers describing original research in all phases of microbiology; review papers will not be accepted. Papers will appear in either English or French, and equal consideration will be given to all manuscripts regardless of country of origin. *Manuscripts received by Apr. 1* will be considered for the first issue. The general instructions to authors given in recent issues of the *Canadian Journal of Botany* should be followed. The subscription rate is $3.00 per volume. Inquiries should be sent to: Accounts Officer, National Research Council, Sussex St., Ottawa 2, Canada.

Chemicals wanted by the Registry of Rare Chemicals, Armour Research Foundation of Illinois Institute of Technology, 35 W. 33 St., Chicago 16: β-chlorolactic acid; barium persulfate; titanium sulfide; dicacodyl; 2,4,6-trinitro-meta-xylene; 2,3,4-trinitrotoluene; 3,3,3-trifluoropropene; 3,3,3-triiodopropene; piperylene; 2-methyl-8-aminoquinoline; lactic aldehyde; 1,2-cyclohexanediamine tetraacetic acid; 2,3-dihydrofuran; 5-amino-1-pentene; ethylenesulfonic acid; melibiase; hedonal; laccase; pseudocholinesterase.

The U.S. Forest Service has spent nine years listing the 1027 species of trees in the United States and Alaska. Elbert L. Little, Jr., of the Forest Service has prepared a 450-page publication entitled **"Native and Naturalized Trees of the United States Including Alaska."** The new listing replaces one made in 1927. It will be used as the standard reference on trees.

The Association of Research Libraries, an organization of representatives of 50 of the largest research libraries in the United States, has in progress a program for making promptly and inexpensively available all **doctoral dissertations** currently accepted by colleges and universities in this country. Forty-three institutions are now publishing all or part of their dissertations in cooperation with this plan. Librarians, constantly faced with slow but steady demand for dissertations through interlibrary loan channels, are generally agreed on the great need for better distribution of this useful material. The members of the ARL believe that the dissertation publishing plan outlined below will secure such distribution, and hope that all institutions granting doctoral degrees will participate.

1. All doctoral dissertations should be published immediately upon acceptance to facilitate more effectual communication of new research material than is possible through the existing costly, inefficient, and incomplete system of interlibrary lending of typescripts of dissertations.

2. A permanent central repository for doctoral dissertations, from which copies could be inexpensively procured at any time, would be maintained to simplify the distribution.

3. Uniform listing, indexing, and abstracting of these dissertations, in one central bibliographical source, should follow as soon as possible upon their acceptance.

To achieve these general objectives, the members of the ARL have endorsed publication of dissertations in microform. Use will be made of the services of University Microfilms, Ann Arbor, Mich. Any institution granting doctoral degrees may participate by writing directly to University Microfilms. Each participating university makes its own decision as to whether the university or the student pays the fee. Various levels of participation are possible.

Necrology

Paul G. Agnew, 72, physicist, author, and former vice president of the American Standards Association, New York, N.Y., Jan. 8; **Benjamin F. Bailey,** 78, inventor and chairman of the Department of Electrical Engineering, University of Michigan, Ann Arbor, Mich., Jan. 8; **Ralph Digman,** 34, assistant professor of geology at Harpur College of the State University of New York, New York, N.Y., Dec. 20; **Irving J. Eales,** 93, author and founder of the American Society for Physio-Medical Research, Dec. 23; **Albert S. Eisenstein,** 35, visiting professor of physics at Cornell University, Ithaca, N.Y., Dec. 16; **Everett I. Evans,** 44, surgeon and head of research in radiation burns at the Medical College of Virginia, Richmond, Va., Jan. 14; **Ellsworth Faris,** 79, former head of the Department of Sociology and Anthropology at the University of Chicago, Chicago, Ill., Dec. 19; **Lynn L. Fulkerson,** 72, inventor, author, and professor of gynecology at the New York Post-Graduate Medical School, New York, N.Y., Dec. 30; **Auckland C. Geddes,** 74, former professor of anatomy at McGill University, Montreal, Canada, Jan. 8; **Bienvenido Ma. Gonzalez,** 60, retired president of the University of the Philippines College of Agriculture, College, Laguna, Philippines, Dec. 30; **Nicholas H. Heck,** 71, former chief of the Division of Terrestrial Magnetism and Seismology of the Coast and Geodetic Survey, Washington, D.C., Dec. 21; **Ames B. Hettrick,** 49, chemical engineer and executive of American Cyanamid Co., Plainfield, N.J., Dec. 27; **George B. Hogaboom,** 79, engineer and authority on electroplating, New Britain, Conn., Dec. 31; **Scott Johnson,** 55, associate professor of medicine at the Cornell Medical College, New York, N.Y., Jan. 15; **Daniel B. Kirby,** 62, specialist in eye diseases and former director of the Department of Ophthalmology at New York University, New York, N.Y., Dec. 27.

Oscar E. Lademan, 78, retired professor of medicine at Marquette University, Milwaukee, Wis., Dec. 15; **Jesse E. Lapham,** 85, retired soil scientist of the Department of Agriculture, Washington, D.C., Jan. 9; **Louis B. Laplace,** 50, cardiologist, gerontologist, and author, Philadelphia, Pa., Dec. 27; **Montgomery E. Leary,** 85, specialist in the prevention and treatment of tuberculosis, and founder of Iola Sanatorium, Rochester, N.Y., Jan. 3; **Edward M. Lehnerts,** 80, founder and retired chairman of the Department of Geology and Geography at Hunter College, New York, N.Y., Dec. 21; **Ralph Linton,** 60, archeologist, author, and Sterling Professor of Anthropology at Yale University, New Haven, Conn., Dec. 24; **Charles H. Lutterloh,** 56, clinical professor of medicine, University of Arkansas School of Medicine, Hot Springs, Ark., Oct. 30; **J. S. Macdonald,** 60, construction engineer, New York, N.Y., Dec. 31; **R. A. Millikan,** 85, Nobel Prize physicist, authority on cosmic rays, and retired head of the California Institute of Technology, Pasadena, Calif., Dec. 19; **John H. Perry,** 58, chemical engineer, Wilmington, Del., Dec. 13; **Patrick T. L. Putnam,** 49, anthropologist, Mombasa, Belgian Congo, Dec. 12; **Emiro Quintero,** 45, director of the Public Health Department of the Ministry of Public Health, Bogota, Colombia, Jan. 2; **Leo F. Rettger,** 79, professor emeritus of bacteriology at Yale University, New Haven, Conn., Jan. 7; **Percival S. Ridsdale,** 81, founder of the American Nature Association and former editor of *Nature Magazine,* Johnstown, Pa., Dec. 23; **Henry P. Rusk,** 69, dean emeritus of the University of Illinois College of Agriculture, Urbana, Ill., Jan. 9; **George E. Russell,** 75, professor emeritus of hydraulics at Massachusetts Institute of Technology, Cambridge, Mass., Dec. 11; **Burrell F. Ruth,** 53, professor of chemical engineering at Iowa State College, Ames, Iowa, Jan. 1.

Erich Seligmann, 73, former professor, author, and senior bacteriologist at Beth Israel Hospital, New York, N.Y., Jan. 1; **Harold M. Shorr,** 36, assistant chief of medical service at the Camp Rucker Hospital, Camp Rucker, Ala., and formerly of New York University College of Medicine, Dec. 16; **James R. Slonaker,** 87, dietetics authority and emeritus professor of physiology at Stanford University, Stanford, Calif., Jan. 3; **Ralph E. Smith,** 79, retired chairman of the Department of Pathology at the University of California, Berkeley, Calif., Dec. 15; **Francis C. Sumner,** 58, head of the Department of Psychology at Howard University, Washington, D.C., Jan. 11; **Verne F. Swaim,** 68, physicist and chief civilian scientist at the Chincoteague Naval Aviation Ordnance Test Station, Chincoteague, Va., Jan. 5; **George H. H. Tate,** 59, Curator of Mammals at the American Museum of Natural History, New York, N.Y., Dec. 24; **Willard C. Thompson,** 63, head of the Poultry Department at Rutgers University, New Brunswick, N.J., Jan. 12; **Frederick Tice,** 82, former professor, author, and specialist on chest ailments, Chicago, Ill., Dec. 18; **Winsor M. Tyler,** 77, ornithologist and author, Brookline, Mass., Jan. 9; **Donald B. Wells,** 69, authority on the treatment of burns, West Hartford, Conn., Dec. 22; **Reinhard A. Wetzel,** 80, retired supervisor of secondary physics at City College, New York, N.Y., Dec. 23.

Technical Papers

Scintillation Counting of Natural Radiocarbon: I. The Counting Method

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Three technics of counting natural radiocarbon are now available: the screen-wall counter of Libby (*1, 2*), gas phase counters in the proportional or Geiger region (*3, 4*), and the scintillation counter (*5*). The first technic is proven and reliable, having been used successfully by a number of workers. The second and third offer special advantages. The gas counter has high efficiency with low background; especially with the use of acetylene (*4*), its sensitivity is very good. For small samples it will probably become the method of choice. The scintillation counter, with moderate efficiency, allows the effective use of large samples, and in principle has by far the greatest ultimate sensitivity of the three. An early attempt by the author (*6*) to develop this method was unsuccessful because of the limitations of the art at the time. Today phototubes of high efficiency and low noise, and liquid scintillators, are available. C^{14} and tritium have been measured at very low levels (*7*). This paper describes the counting technic developed in this laboratory for natural radiocarbon measurements.

The last two rows give a measure of the statistical precision of each method. It should be stressed that other experimental errors are possible, and that it is a matter of laboratory technic to reduce them to unimportance. Errors intrinsic in the method, such as isotopic fractionation, chemical exchange, and fluctuations in the natural abundance of C^{14} have proved to be relatively minor for the screen-wall technic. A notable improvement in accuracy will require reevaluation of these problems. It would be premature to claim that an error in dating of ±17 years can be achieved in practice. It should be added, however, that both the gas-counting and scintillation-counting methods should prove rather free of the contamination problems that have plagued a number of workers using the screen-wall method.

The chief limitation of the scintillation counter, since tubes of high photo-efficiency and low noise became available, has been the stability of the electronic system. The counting rates shown in column three of Table 1 are easy to achieve, and would allow far greater sensitivity than the screen-wall counter for measurement of C^{14}, if the precision were limited by statistical error. Background drifts of 2–3% make this increased sensitivity useless for precision work, however, and result in accuracy not appreciably better than that of known technics. Our method overcomes this problem while actually increasing the sensitivity of the instrument.

TABLE 1.

	Screen-wall counter a-c shielding (*1*)	Gas counter (acetylene) (*4*) a-c shielding	Scintillation counter 100-ml cell vol		
			33% ethanol no upper gate	33% ethanol pulse height disc.	80% paraffin pulse height disc.
Sample size	8 g	3 g	14.2 g	14.2 g	47 g
Counting efficiency	5.4%	75%	45%	25%	25%
Net sample counting rate	6.7 cpm	34.5 cpm	97 cpm	54 cpm	182 cpm
Net background counting rate	4.0 cpm	30.0 cpm	270 cpm	26 cpm	26 cpm
Statistical error, 2-day count	1.5%	0.7%	0.7%	0.46%	0.20%
Statistical error, in years, 2-day count (contemporary)	120	55	55	37	17
Maximum age limit ($S = 4\sigma$)	25,000 yr	30,000 yr	29,000 yr	34,000 yr	44,000 yr

Representative data for each method are shown in Table 1. The first two columns are based on data of Libby *et al.* (*1, 2*) and Crathorn (*4*). The third and fourth are data on natural radiocarbon obtained in this laboratory. The fifth shows values calculated from data on a sample of active polystyrene in a solution of 0.4% diphenyloxazole in 80% heptane-20% toluene. All are for 100-ml cell volume.

A block diagram of our apparatus is shown in Fig. 1. The tubes and sample cell (of 100-ml volume) are enclosed in a mercury shield, inside a deep-freeze held at −20° C. The preamplifiers are attached to the shield. The gain of the preamplifiers is 30, and that of the main amplifiers is about 2500. This high overall external gain effectively eliminates what Hayes calls "light dark current," by reducing the internal gain of the phototubes and thus the number of light quanta they produce. The phototubes are DuMont type K1192, and show low noise with high sensitivity, when

[1] The author is indebted to E. C. Anderson and F. N. Hayes for valuable discussions of this problem and for access to unpublished data and new scintillation materials.

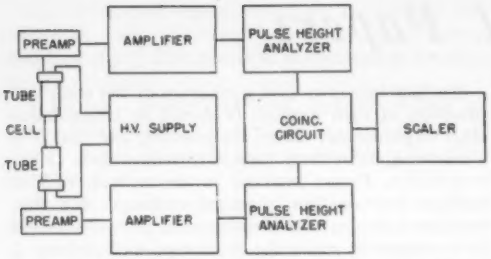

FIG. 1. Block diagram of counting apparatus.

the screen is connected with the first dynode. The speed of the amplifier is of the order of 1 μsec, and this effectively controls the time constants of the rest of the circuitry. Faster circuits were considered but not adopted, since at the noise levels now observed the accidental coincidence rate is negligible.

The pulse height analyzers are designed for wide-gate operation; the use of 6BN6 tubes allows a gate width of 85 v to be reached, which is desirable for C^{14} in view of its broad spectrum as observed in liquid scintillators.

All electronics, except the scaler, are run from a voltage-regulated supply, and are designed for stability and (in the case of the amplifier) excellent overload characteristics.

The liquid phosphor used is basically a solution of 0.4% diphenyloxazole (PPO) in toluene, with 20 ppm of diphenylhexatriene (DPHT) as a spectrum shifter. These materials show excellent compatibility with various organic liquids at −20° C, whereas terphenyl, for example, is almost insoluble at this temperature. The basic phosphor solution is as good as any known. An increase in light output of 20–30% can be achieved by thorough flushing with N_2.[2] Further gains result from adding other components such as diphenyloxadiazole (PPD) to the solution but these are thus far too small to justify routine use.

Various organic liquids are compatible with this solution, without quenching the fluorescence excessively or causing precipitation of the phosphor. The solvent can be replaced with up to 40% methanol or ethanol, or up to 80% aliphatic hydrocarbon before the integrated C^{14} efficiency drops from 80 to 45%. Ketones and carbon disulphide act to quench the fluorescence. In our preliminary work ethanol has been used as sample since it is available from both fermentation and petroleum sources.

The background observed in this instrument, with upper gates not in use, is about 270 cpm. Only about 15 cpm of this can be due to mesons; the rest must arise from hard gamma contamination. The pulse heights are, on the average, several times higher than those due to C^{14}. It is this fact that makes pulse height discrimination so useful.

If, for example, the base line of the discriminator is set at 7 v, and the gate width at 60 v, the background and C^{14} count rates show a variation with high voltage as shown in Fig. 2. Since tube gain rises as a large power of the high voltage, simulating an exponential rise over a considerable range, this plot may be thought of as a reversed logarithmic pulse height spectrum for the two types of pulse. The peak in background comes at a considerably lower voltage than that of the C^{14} spectrum; the slight rise in the background rate at 1500 v is due to "light dark current."

The essential feature brought out by these curves is that the pulse height spectrum of the background has a broad minimum and the C^{14} spectrum a maximum at about the same voltage. Further, small adjustments of the phosphor efficiency can be made quite easily by bubbling N_2 or O_2 through the solution (the latter acting to quench the fluorescence and the former removing dissolved air). Thus the minimum of the background spectrum can be made to coincide with the maximum of the C^{14} spectrum. This operating point is called the balance point.

This is the most favorable operating voltage from the point of view of sensitivity and it is also the most stable position. Drifts in the high-voltage supply, preamplifiers, amplifiers, or pulse height analyzers are all compensated for, as all cause a proportional shift in the upper and lower gates. Even small changes in optical efficiency of the system operate in the same way.

When the apparatus is operated at the balance point, with a base of 7 v and gate width of 60 v, a solution of 1/3 "contemporary" ethanol and 2/3 phosphor solution shows a net effect of 54 cpm against a background of 20–26 cpm for a similar solution of "dead" ethanol, corresponding to 25% efficiency for C^{14}. A further, fortuitous element of stability is that this efficiency is almost independent of the integrated efficiency of the phosphor, over the range from 80% (characteristic of pure phosphor solution) to 45%. The efficiency can be checked accurately by comparison with a known standard added at the end of a run.

To test the capabilities of the apparatus, a series of three test samples was run. The first was pure living

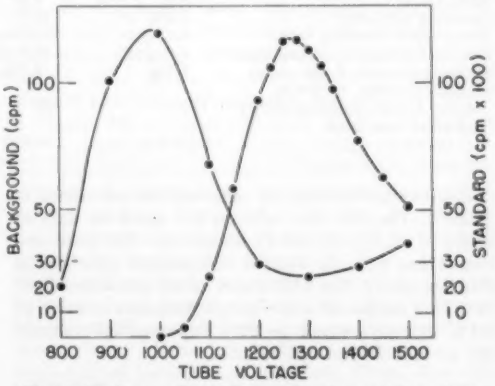

FIG. 2. Background and C^{14} count rate vs. tube voltage. The base level is 7 v and the gate width is 60 v.

[2] This important effect was first called to our attention by Dr. B. Lionel Funt.

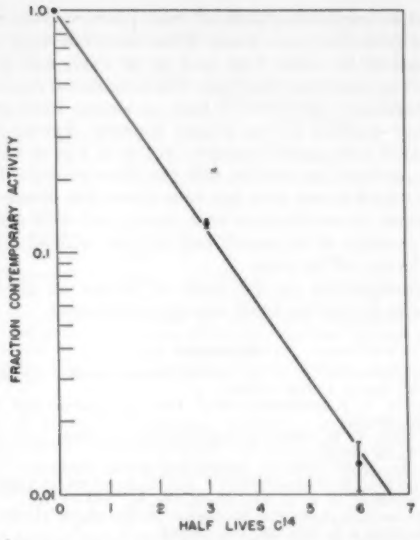

FIG. 3. Count rate vs. "age" for a series of synthetic samples. The line is drawn through the contemporary point with the theoretical slope.

alcohol, and the others were mixtures of 1/8 and 1/64 parts living alcohol with 7/8 and 63/64 parts dead alcohol, respectively. These samples simulate "ages" of 3 and 6 half-lives of C^{14}, respectively. The results are shown in Fig. 3, where the errors shown are the statistical counting errors (standard deviation) alone. The straight line represents the decay of C^{14}. It is seen that the samples agree within the statistical error. The counting data are internally consistent in the same way.

The value of the contemporary assay of natural C^{14} obtained from these data is 15.2 dpm/g carbon. This is in excellent agreement with previous data (*1*), but since our figure is based on an Oak Ridge standard of uncertain accuracy, its value is doubtful.

This method allows us to measure natural C^{14} to a precision of 0.46% in 48 hr, compared to 1.6% for the screen-wall counter technic. Six half-lives are well within reach, as the curve shows. A method for converting samples to aliphatic hydrocarbon is being worked out, so that solutions of good efficiency can be prepared that are 80% sample. This will allow a further extension of two half-lives. The cell size of 100 ml represents an arbitrary choice, and we believe that cells up to 1 liter or more in size are feasible with present equipment. Finally, the experiments of Cowan *et al.* (*8*) indicate that there is no natural limit to sample size, if sufficient starting material is available. We expect that it will be practical to extend the method to the point where its assumptions break down.

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Preliminary Investigations on the Role of Alfalfa Saponin in Ruminant Bloat

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Saponin has been suggested by several investigators (*1–5*) as being a contributing factor in the pathogenesis of ruminant bloat, especially "frothy" bloat. However, its exact role has been open to speculation for a number of years. Jacobson (*6*) isolated a compound from alfalfa that he regarded as a saponin as early as 1919. Boas and Steude (*7*), Jaretsky (*8*), Jaretsky and Lindner (*9*), Henrici (*5*), and Walter, Van Atta, Thompson, and Maclay (*10*) have now definitely established that at least 2 different saponins can be found in alfalfa. The only previous experiment described in the literature to ascertain the effect of feeding ruminants saponin actually derived from alfalfa was performed by Jacobson (*6*). Jacobson fed a sheep 19 g of his saponin preparation and reported that the animal suffered no ill effect. However, serious doubts have been raised as to the identity of Jacobson's product as a saponin because it contained combined nitrogen and did not hemolyze blood (*7, 8*).

The recovery of several pounds of a composite alfalfa saponin was undertaken at the Western Regional Research Laboratory to serve as starting material for isolation of the individual saponins and to provide a sufficient quantity for testing its activity as a factor in ruminant bloat.

This paper briefly describes the method used in the recovery of the alfalfa saponin and the results obtained with it in animal tests. The latter were carried out in the Animal and Poultry Husbandry Research Unit at the Agricultural Research Center.

Recovery of Alfalfa Saponins. The procedure for preparation of the composite alfalfa was as follows: Dehydrated alfalfa was extracted exhaustively with boiling water and the aqueous solution concentrated to about 50% solids *in vacuo*. Alcohol (95%) was added to yield an 80% alcohol solution which precipitated protein, salts, etc. The alcohol solution was decanted, evaporated *in vacuo* to 50% solids to remove alcohol, and the residue boiled with powdered cholesterol. The cholesterol-saponin addition product was filtered off,

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washed with water, dried, and dissolved in pyridine. Saponin was precipitated by addition of anhydrous ethyl ether. The precipitate was filtered off, washed with ether, and dried. Yield was about 0.5% of the dry weight of alfalfa.

Animal Tests. Five yearling ewes, two goats, and one heifer were used in the tests, following preliminary testing for susceptibility to bloating. In this preliminary treatment the animals were pastured on alfalfa or ladino clover for several days and then drenched with ladino clover or alfalfa juice. None of the animals displayed any signs of bloating from natural grazing, but all bloated when drenched with clover or alfalfa juice. This procedure was considered to be necessary, since bloating under natural grazing conditions has been almost nonexistent at the Agricultural Research Center for several years.

The classification of bloat obtained during the tests was based on the following factors: (1) the amount of distention of the rumen, (2) the tightness of the distention, and (3) the discomfort of the animal. A rating of severe has been reserved for a case resulting in death or in which the animal must be treated immediately to prevent death.

In the 10 different tests in which alfalfa saponin was administered to ruminants, definite distention of the rumen was obtained in 8 cases. The distention obtained in these cases was rated from light moderate to moderate bloat when 15 to 25 g of saponin was administered to 5 sheep and 1 goat, moderate to severe when 55 g of saponin was given to another sheep, and light moderate when 75 g was given to a heifer. During the tests the saponin was dissolved in 1 pt to 1 qt of water and administered to the animals by using a stomach tube. In general, the height of the distention of the rumen occurred in 30 to 45 min with the alfalfa saponin as compared to 10 to 15 min when using alfalfa or ladino clover juice drenches. Only a very slight distention was produced when 15 g of alfalfa saponin was given to ewe No. 44 while grazing on a grass pasture. No distention of the rumen, however, has been produced in a number of attempts where sheep, grazing on a grass pasture, were drenched with ladino clover juice or alfalfa juice. When ewe No. 44 was grazing on ladino pasture, 25 g of the alfalfa saponin produced a distinct distention of the rumen. No reaction was observed when 15 g of alfalfa saponin was given to a mature goat. However, this goat required twice as much ladino clover juice to produce a distinct distention of the rumen as was required by the sheep used.

In all cases, the distention appeared to be due to gas retention rather than froth, since the passage of a stomach tube into the rumen permitted an immediate release of gas and reduction of distention.

No detectable distention of the rumen was produced by giving two to three times the amount of water used in the above tests. In subsequent tests, all the sheep were each given 50 g of a commercial 50% saponin solution labeled by the manufacturer as nontoxic and 25 g of another commercial saponin preparation labeled as being toxic. Both of these products were isolated from the yucca plant. These materials were administered in either 1 pt or 1 qt of water and produced no detectable reactions. The commercial saponin preparations appeared to have as strong foam-producing qualities as the alfalfa saponin. Twenty-five grams of a household detergent in 1 pt to 1 qt of water also produced no reaction with the above animals. The heifer used in the tests has been given this detergent in water, in combination with sugar, and with sugar and aeration of the rumen with oxygen, without reaction in any of the tests.

Investigations on the mode of action of alfalfa saponin in ruminal bloat are being continued.

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A Study of the Relationship between Asymmetric Acetylcholinesterase Activities in Rabbit Brain and Three Behavioral Patterns

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Involuntary behavior such as the forced circling preceding certain types of epileptic attacks is frequently associated with a lesion in a specific area of the cerebral cortex. Such compulsive turning also has been produced experimentally by extirpation of a portion of the frontal cortex in monkeys (*1*). Mettler (*2*) has shown that bilateral frontal lobectomy plus unilateral caudate ablation in cats may also result in forced circling. The animal may progress in a straight line, but more usually it circles and occasionally will spin on its hind legs. In most cases the circling is toward the side of the caudate lesion, but it may be in the opposite direction. It should be pointed out that the mechanism of forced circling probably involves additional structures in the central nervous system (*3, 4*).

It has been previously demonstrated that a biochemical lesion of the brain can be produced by the intracarotid injection of diisopropyl fluorophosphate (DFP) which under this condition inhibits the activ-

[1] The authors acknowledge the valuable technical assistance of Madeline Griffin and Shirley Moak.

TABLE 1. Acetylcholinesterase activities expressed as percent of normal in rabbits after intracarotid injection of DFP.

Tissue	Data Expressed as Percent of Control*		
	"Lefters"	"Righters"	"Neutrals"
Right cortex	20	27	86
Left cortex	90	54	88
Right caudate nucleus	3	6	82
Left caudate nucleus	83	84	98

* Nine rabbits were used for the control series and 6 rabbits for each of the other categories. "Lefters" turned away from the injected right side, "righters" turned toward the injected side, and "neutrals" did not exhibit compulsory behavior.

ity of acetylcholinesterase (AChE) in the parts of the central nervous system irrigated by branches of the common carotid artery (*5, 6*). This lesion evokes compulsory turning of the animal in a direction away from the injected side (*6, 7*). Although forced turning away from the injected right side ("lefters") is the pattern usually observed, it was noted that sometimes the direction of the turning is reversed, i.e., toward the injected side ("righters"), and in some cases the animal does not exhibit any compulsory behavioral pattern ("neutrals").

In our experiments 0.1 mg/kg of DFP was injected into the right common carotid artery of rabbits weighing approximately 2 kg, in order to study the enzymatic changes that were associated with the behavioral responses. The AChE activity of the frontal cortex and caudate nucleus on both sides of the brain was measured in animals exhibiting each of the three behavioral patterns. A series of control animals was obtained by substituting water for the DFP in the carotid injections.

After a 20-min period in which a single behavioral response became well established, the animal was sacrificed by an injection of air into the marginal ear vein. The tissue to be analyzed was then removed and the AChE activity was measured by a continuous titrimetric method. The enzyme activity was calculated and expressed as mg of ACh hydrolyzed per mg of wet tissue per min. A more detailed study and description of the method will be reported elsewhere.

The AChE activities are expressed as percent of normal in Table 1. The data reveal a general decrease of AChE activity in the tissues studied following the intracarotid injection of DFP. However, in "lefters" and "righters" this decrease was very much greater on the right side of the brain than on the left. This large difference between the two sides, or asymmetry of enzyme activity in the cortex and caudate nucleus, was noted in every rabbit that exhibited the circus movements irrespective of the direction. In "righters" the AChE activity for the left cortex is relatively low when compared to the "neutrals." However, the asymmetry of AChE activity between the left and right cortices is still present because the right side has suffered a far greater decrease than has the left. That this asymmetry of AChE is associated with forced circling is further emphasized by the fact that it is absent in the "neutrals."

We have thus been able, by the production of an asymmetric biochemical lesion, to duplicate behavioral patterns previously obtained by extirpation or by electrical stimulation of specific cerebral areas. We now find that a characteristic AChE pattern in the cortex and caudate nucleus is associated with each behavioral response. These results further support the concept that cortical and subcortical structures are involved in forced turning (*2*).

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Rotating Sector Method Applied to Reactions Induced by Co^{60} Gamma Rays

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Intermittent illumination has been extensively used in photochemistry but its application in radiation chemistry has been much more limited (*1*). This has been partly due to technical difficulties associated with the penetrating nature of the radiations used and partly to a lack of sufficiently strong sources of radiation. Hart and Matheson (*2*) obtained intermittent illumination of their samples by placing them on the circumference of a wheel rotated in front of an orifice in a lead shield behind which there was an 80-curie cobalt source. In the present work a rotating sector was constructed which could be placed between a 1000-curie cobalt source and the samples to be irradiated, thus allowing the samples to remain stationary during irradiation. The sector was a solid steel cylinder, 6 in. in diameter, 1 ft long, with two 60° sectors cut out on opposite sides. It was connected through a series of pulleys to a variable speed motor (see Fig. 1).

Two systems have been investigated, one molar aqueous chloral hydrate solution and chloroform saturated with water. These particular systems were chosen

[1] The authors are indebted to the Defence Research Board of Canada for financial assistance, and to the Saskatchewan Cancer Commission for the use of the 1000-curie cobalt unit.

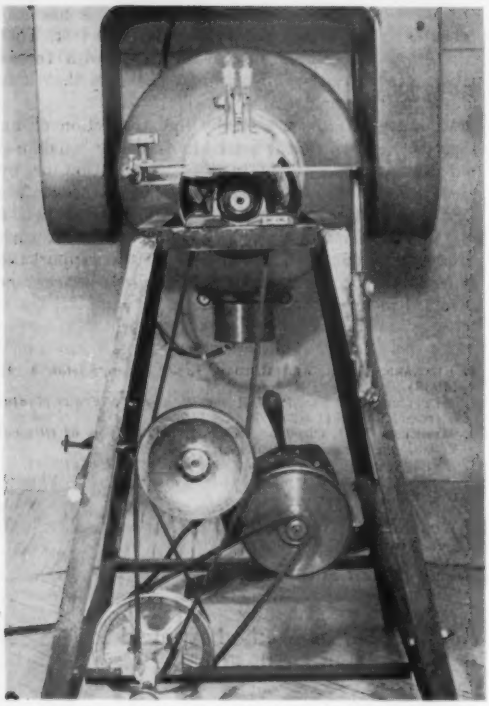

FIG. 1. Rotating sector and irradiation cells in front of Co^{60} bomb.

since they are chain reactions exhibiting a nonlinear dependence of rate of reaction on dose rate (*3, 4*). The dose rate under constant irradiation was 1200 r/hour, and the dark to light ratio was 2 : 1. Pairs of samples were irradiated in the beam of gamma rays with the sector rotating at various speeds. The amount of acid found was compared with that found in pairs of samples irradiated in the beam for one-third the time with the sector stationary. The results are recorded graphically in Fig. 2 as

$$\% \text{ diff.} = \frac{(\text{acid formed when sector stationary}) - (\text{acid formed when sector rotating})}{(\text{acid formed when sector stationary})} \times 100.$$

The figure indicates that the average free radical chain lifetime in the chloral hydrate solution under these conditions was approximately 0.1 sec and that in the chloroform system was approximately 1 sec. These lifetimes are only approximate, since the reaction mechanisms are not known.

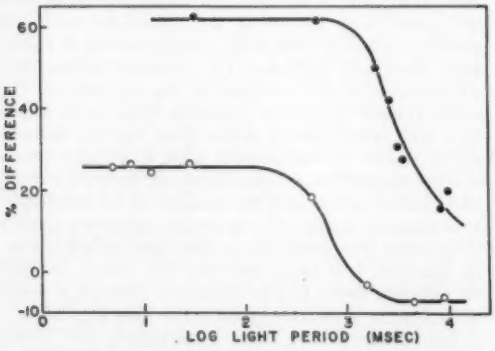

FIG. 2. Variation of acid production with length of irradiation period (all results referred to samples given the same dose continuously at the rate of 1260 r/hr) ○, chloral hydrate solutions; ●, chloroform saturated with water.

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Results of Dialyzing Some Fish Poisons[1]

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Clinical reports by Khlentzos (*1*), Lee and Pang (*2*), Larsen (*3*), Watanabe (*4*), and others indicate that ichthyosarcotoxins from many fish species are powerful neurotoxins. Japanese investigators have studied quite extensively the chemical properties of puffer toxin, which have been reviewed by Yudkin (*5*). However, the chemical and pharmacological properties of fish toxins exclusive of puffer poison have not been studied to any extent. General reviews of the overall problem of poisonous fishes and ichthyosarcotoxism have been written by Phisalix (*6*), Pawlowsky (*7*), and Halstead (*8, 9*).

The present study was conducted preliminary to more extensive work on the chemistry and pharmacology of *Gymnothorax* (moray eel) and *Lutjanus* (snapper) poison. Specimen material consisted of fresh frozen Japanese puffer, *Fugu rubripes chinensis* (Abe), from Tokyo, Japan; cooked moray eel, *Gymnothorax* sp. indet., from Kwajalein, Marshall Islands; fresh frozen red snapper, *Lutjanus vaigiensis* (Quoy & Gaimard), from Palmyra Island; and fresh frozen *Caranx melampygus* Cuvier, from Palmyra Island. *Fugu* extract No. 1 (Table 1) was prepared from

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[2] The authors are indebted to John Field, Department of Physiology, School of Medicine, University of California at Los Angeles, for his helpful suggestions and criticisms.

TABLE 1. Dialyzation results.*

Fish species	Sample	Original extract		Dialysate		Residue	
		Deaths no. inj.	Av. death time	Deaths no. inj.	Av. death time	Deaths no. inj.	Av. death time
Fugu rubripes chinensis	(1)	4/4	24 min	8/14	41 min	0/6	+
Fugu rubripes chinensis	(2)	4/4	3 min	30/32	4.7 min	19/34	15 hr
Gymnothorax sp. indet.	(1)	4/4	16 min	1/4	16 hr	0/4	+
Gymnothorax sp. indet.	(2)	4/4	24 hr	0/8	+++	4/8	24 hr
Lutjanus vaigiensis	(1)	21/43	24 hr	0/54	+	9/56	28 hr
Lutjanus vaigiensis	(2)	1/4	24 hr	0/12	++	0/12	+
Caranx melampygus		4/8	30 min	0/28	++	0/28	+

* Sublethal response recorded as: + occasional symptoms; ++ mild to acute symptoms in most mice; +++ entire group extremely distressed.

liver, and extract No. 2 from viscera (pooled liver, intestines, and gonads). *Gymnothorax* extracts Nos. 1 and 2 were from separate batches of muscle. *Lutjanus* extracts Nos. 1 and 2 were prepared from viscera. No. 1 was stored in the frozen state until tested; No. 2 was tested immediately on preparation. The *Caranx* extract was a sample of liver and gonads. Two milliliters of distilled water were used for each gram of tissue. The material was then homogenized in a Waring Blendor and centrifuged at 2000 rpm for 25 min. Aliquots of these extracts were dialyzed against distilled water that had been sterilized by autoclaving. Dialysis was conducted in the cold (38–42° F) for a minimum of 24 hr. The dialyzate was concentrated by distillation under low pressure and the volume adjusted to be equal to that of the original aliquot. The original, the concentrated dialyzate, and the residue were all injected intraperitoneally in 1.0-ml volumes into three separate groups of weanling mice of the California Caviary Strain No. 1, weight 15–23 g. Symptoms were observed for a minimum of 36 hr.

The data show that the dialyzate under the conditions of these experiments has a measurable toxicity. When it is considered that the dose-response curve for these toxins shows a large increment in response for a small increment in dosage, with a very small dose range between ED_1 and ED_{100} (*10*), it is obvious that a considerable fraction of the toxin has penetrated the membrane,[8] and it is therefore a fair inference that the toxin is a small molecular species.

There is an apparent difference in percentage distribution of the toxin between dialyzate and residue in the four species tested. This could be explained as either a function of concentration gradients, or actual differences in molecular species. Our present data do not resolve this question, but indicate that the toxin from each of the four species is a small water-soluble molecule.

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[8] Cellophane dialyzing tubing, Braun Corp., No. 25 225, ¾-in. width.

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Movement of Yolk Cells in the Silkworm (*Bombyx mori* L.)

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In the silkworm, *Bombyx mori* L., the egg, as in many other insects, contains a large quantity of yolk which is nonliving and is used for nutrition of the embryo. Covered with this huge amount of yolk, the activity of the yolk cells themselves, which contain the yolk and provide for the embryo, is often overlooked.

The behavior of the living yolk cells in hanging drops has been studied and it has been found that the yolk cells show active movement *in vitro*. This is a fact that has not yet been reported about *Bombyx mori* or presumably the other insects, and seems worth describing.

A drop of 0.9% NaCl solution was spread on the underside of a cover slip. The yolk was added to it, and the cover-slip was sealed to a depression slide with petroleum jelly.

In the silkworm egg, fertilization takes place within 2 hr after deposition. At about the 24th hr the yolk segmentation begins and the yolk mass is divided by thin membranes into many large cells that contain several groups of nuclei surrounded by dense masses of fatty globules and a large quantity of protein globules. These large cells are subdivided into much smaller yolk cells, or so-called "yolk segments," which are mononuclear, as usually seen.

The moving yolk cells observed *in vitro* show a peculiar shape. They have a concave portion and a satellitic projection at that portion (Fig. 3), and move toward the direction of the headlike extension. The maximum moving velocity in these experiments was 13.18 μ/m.

Many cells cease movement within about 1 hr or so

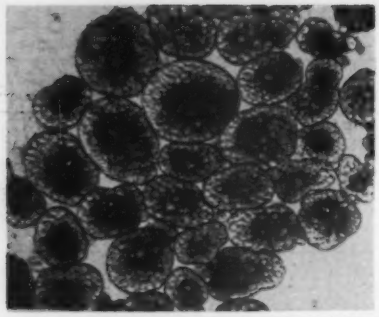

FIG. 1. Resting yolk cells from a hibernating egg at the beginning of incubation. Photographed about 5 min after the explantation (ca. ×280).

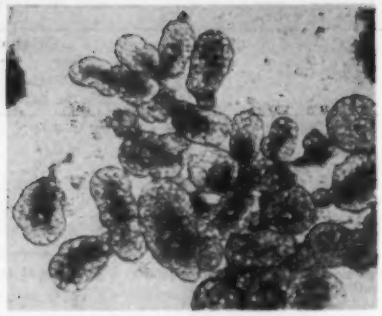

FIG. 2. Yolk cells changing form in the same preparation as shown in Fig. 1. Photographed 30 min later (ca. ×280).

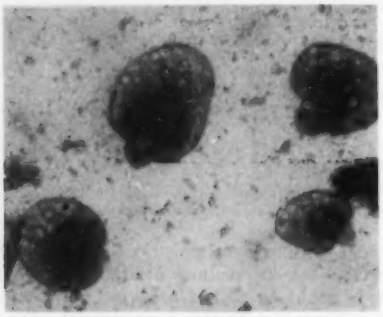

FIG. 3. Moving yolk cells (ca. ×400).

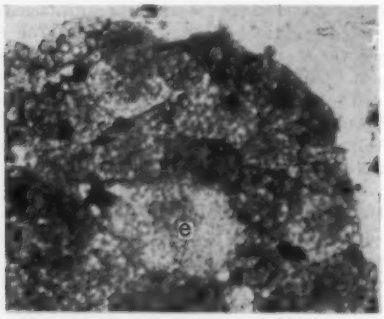

FIG. 4. Tissuelike grouping of yolk cells. e, embryo (ca. ×300).

after the explantation. They recover their round shape, and the neighboring cells come into intimate contact with each other to form tissuelike groups (Fig. 4). But some cells often continue to move for several hours, as seen under the microscope.

In hibernating eggs the active movement period of yolk cells covers about 1 wk or more, beginning about 40 hr after deposition. Then the yolk cells gradually become less active. In the nonhibernating and artificial nonhibernating eggs this period is very short, and continues only for a day or less. In these nonhibernating eggs the movement of yolk cells is not restored, whereas in the hibernating egg it is restored at the beginning of the next spring and is retained until just before the time of the curvature reversal of embryos.

Manuscript received August 26, 1953.

Communications

Unpopular Science

AT a recent meeting of representatives of federal agencies sponsoring biological and medical research, the question of the limitations imposed on scientists in regard to travel and security was discussed. I expressed the belief that both are merely symptoms of a growing distrust of science and scientists. This matter has concerned me for a long time. The problem is indicated by a number of phrases and statements (some only approximate quotations) which have appeared in speeches, articles, and books, particularly during recent months.

"Science is in conflict with society. . . . Science has failed. . . .Science is charged with some, if not most, of the failures, violence, brutalities, suffering and confusion of our times. . . .There is a growing anxiety to minimize and localize science. . . .Science is tolerated only on its best behavior. . . .It has become a passion and a luxury. . . .A sacred cow. . . .A cult of men in white coats. . . .Its revelations have been considered alien to the human spirit. . . .It will destroy civilization. . . .There is a steady hunger for irrationalism—unscientific and antiscientific

attitudes of mind. . . .Scientists are valuable but untrustworthy. . . .There is a widespread tendency in the public mind to identify science with destruction. . . .Science must not be permitted to go on a rampage. . . .Science is respected for its power; not for its spirit. . . .Moral incompetency of science. . . .A revulsion against science is said to be in the making. . . .Disappointment and suspicion enshroud science. . . .Hovering over science are storm clouds of suspicion, recrimination and fear. . . .There is abundant evidence to indicate a serious decline in the popularity of science and scientists during the past few years. . . .Scientists have been more pushed about by U.S. security regulations than any other group in our society. . . .Touting for their precious freedom, scientists are really speaking of permissive freedom—exemption from legal restraint in pursuit of knowledge. . . .Let's demand a moratorium on science."

This is only a small sample of expressions which I believe reflect attitudes now in ascendance. The trend may be insignificant, transitory, or even imaginary; or it may be very real and serious. Irreparable damage may be done before it is apparent. Of course, critics of science have always been with us and science from its beginning has contended with these attitudes. The contemporary criticism, however, while exhibiting the same ignorance and lack of understanding, is arising in new and powerful quarters, is aimed at our basic philosophy, and appears to be building up to the point where the "sins of science" is a popular topic of conversation.

Some of the causes of the adverse developments appear to be:

1. The concept that science and religion are in opposing camps—suspicion that science is largely responsible for whatever degree of abandonment there has been of moral principles and ethical standards.
2. The internationalistic outlook of scientists—misunderstanding of the scientific philosophy of free exchange of information.
3. Social neutrality of science—the detachment—the indifference of scientists to public attitudes—the practice that some scientists have of setting themselves apart, above, and beyond the rest of society.
4. The ridicule of areas of knowledge not subject to precise measurement, the disagreement among scientists themselves as to what can legitimately be considered "scientific."
5. The time lag between the views held by scientists and public awareness of such views.
6. Fear and resentment of the "destructive" power of science.
7. Disappointment in the wake of the exaggerated hopes penned by newspaper and magazine writers.
8. The extraordinary scientific illiteracy in America even among intelligent, educated people—ignorance of the basic precepts without which there would be no science at all.

The situation demands further study of causes and solutions. Science needs no special pleaders, but respect is a necessity and can come only with understanding. Scientists are dependent upon society for their privileges and it behooves them, no matter how many years it may take, to communicate a more accurate conception of science to as many people as possible. Naïve as it may sound, I am urging a deliberate effort to disseminate widely the story of science and the habits of thinking which underlie it.

Government scientists, particularly those dealing with administration and policy matters, are in a unique position to contribute to this effort. It seems to me that we not only represent science and scientists to our Government, but we also represent our Government to the scientific community. It is our responsibility to promote understanding and to resolve problems threatening their mutual interest. For example, if the structure upon which science has grossed its achievements is threatened by Government-sponsored intimidation and hysterical security regulations, or if our Government is threatened by dangerous views and affiliations of politically naïve scientists, we must in either case, or both, do more than observe the phenomenon. We must assume the freedom and take the risk, if necessary, of promoting a satisfactory general policy as well as safe and fair decisions in the individual cases.

When any misunderstanding, disappointment, or unjustified criticism arises, it must be met with an adequate, honest, and intelligent response. Some appropriate and respected organization should make a business of this. Of the three existing agencies—the National Academy of Sciences, the American Association for the Advancement of Science, and the National Science Foundation—which by charter have broad responsibilities for the welfare of science in the United States, can we hope that at least one of these will take the immediate initiative?

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[1] The opinions expressed herein are those of the author and do not in any way represent official statements from or reflect the policies of the Office of Naval Research, Department of the Navy.

Received December 10, 1953.

Nomenclature of the Amines Derived by Decarboxylation of Cysteine and Cystine

THERE exists some confusion in the biological literature about the chemical significance of the name cystamine. The importance of β-mercaptoethylamine in the chemistry of coenzyme A and in protection against ionizing radiations suggests the necessity of a trivial name, for the specific purposes of biological discussions, which shows its relation to cysteine and avoids confusion with the corresponding disulfide.

We agree to accept *cysteamine* for β-mercaptoethylamine ($HS—CH_2—CH_2—NH_2$) and *cystamine* for β,β′-diaminodiethyldisulfide

$$\begin{array}{l} S—CH_2—CH_2—NH_2 \\ | \\ S—CH_2—CH_2—NH_2 \end{array}$$

It is pointed out that cystamine is given with the suggested meaning in *Beilstein Handb. org. Chem.* (1942), but that in the Merck Index, cystamin is given as a trade name for hexamethylenetetramine.

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The Brocken Spectre of the Desert View Watch Tower, Grand Canyon, Arizona

THE Watch Tower spectre is beautiful and is rarely seen. It forms only when the Grand Canyon at Desert View (southeast portion of the Canyon area) is filled to a proper depth with clouds that can act as a horizontal screen for the projected shadow of the tower. Charles Farmer, tower supervisor, stated that during his twenty years of duty at Grand Canyon he had never seen the spectre before 1952. During this year, it formed once in the spring (date unknown) and again during the afternoon of December 1. It was during this last appearance that I was able to make a brief study of the phenomenon.

The spectre consists of a series of colors which are or bow around the shadow of the tower (Fig. 1). Yellow was innermost, with reds and purples forming the intermediate and outer bands. Cloud particles diffused the colors along their adjacent edges and formed many interesting blends. Later the same day, the spectre shifted and was centered over the shorter shadow of the kiva section of the tower.

When the tower and bow of colors were first noticed during the spring occurrence, it was about 9:00 A.M. The erect shadow of the tower, and the spectre were then projected on the clouds 200 feet below the north rim, which is about nine miles northwest of the tower. Elevation at the tower is 7452 feet and at the north rim it is about 8300 feet at the Canyon edge. According to Mrs. Farmer, who was on duty at the tower that day, the spectre stayed with the shadow as it was shortened by the rising sun and moved from the west toward the east. As late as 4:00 P.M., the spectre was still visible in a small side canyon lying about ENE of the tower; the shadow was then about 400 feet in length. The bows of color subtended angles (measured from the tower) of less than one degree near the north rim, to approximately ten degrees late in the afternoon of the same day. When the phenomenon was observed on December 1, it was about 3:00 P.M. The shadow at this time extended for about 500 feet NE of the 70-foot tower.

Colored photographs have been taken of the phenomenon by Virgil Gipson, local Fred Harvey photographer, and Charles Farmer of Desert View. However, diffusion by the cloud particles usually causes the pictures to have indistinct lines and fuzziness. Unlike true rainbows, the outer band of color is reddish violet instead of red. To further complicate matters and defy explanation, the innermost color is yellow, hence it is neither a true rainbow nor an inverted one.

According to Louis Shellbach, park naturalist at Grand Canyon National Park, a bow of colors formed around the projected shadow of Yaki Point during late January or early February, 1940 (time of day unknown). He had ridden a pony to the point and thought that he could even see his shadow in the middle of the display of colors. E. T. Christensen, assistant park naturalist, reports that he has seen bows of color form around the projected shadows of Yavapai Observation Station (two miles northeast of Yaki Point and about 17 miles west of Desert View) on several different occasions when the Grand Canyon was filled with clouds.

Similar displays of bows of color were reported by Frank Sylvester, headquarters district ranger at Grand Canyon, during plane flights over the South Pacific during World War II. Frequently such displays of color entirely circumscribed the shadow of his plane, when flying between the sun and a cloud. No data were available concerning the distribution of colors around the shadows of the airplane, Yaki Point, or the Yavapai Observation Station.

Some observers of the phenomenon at Desert View have advanced the theory that it is caused by the refraction of sunlight through the windows at the top of the tower. This is rather doubtful because these windows are only a few feet square and probably would not pass sufficient light to project the nine miles to the north rim. Another theory involves multiple diffraction of the sun's rays as they pass between the tower and Canyon clouds. This principle is

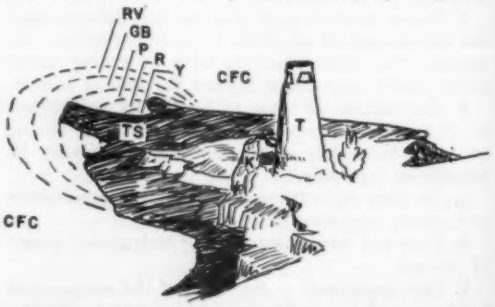

FIG. 1. Diagram of the brocken spectre, Desert View Watch Tower, and its shadow; not to scale. Symbols: CFC, cloud-filled canyon; GB, Greenish blue; K, kiva; P, purple; R, red; RV, reddish violet; T, tower; TS, tower shadow; and Y, yellow.

easily illustrated by shining a flashlight beam against the upright cap of a fountain pen and projecting the latter's shadow on a horizontal sheet of white paper. One heavy shadow and several lighter ones will be cast. Variations of the intensity of light of the minor shadows are due to the degree of reinforcement of the light rays (principle of Newton's rings). The actual breakdown of the sunlight into the various bands of color probably is accomplished by the moisture particles of the Canyon clouds.

An even more likely explanation of the phenomenon is that advanced by W. J. Humphreys:[1]

> Glory or Brocken-Bow. . . . When favorably situated, one occasionally may see rings of colored light around the shadow of his own head as cast upon a neighboring fog bank or cloud. This phenomenon, to which several names have been given—glory, Brocken-bow, Brocken-spectre, mountain-spectre—is produced by the diffraction by particles comparatively near the surface of light reflected from deeper portions of the fog or cloud.

[1] *Physics of the Air*, 1920, p. 537.

The reflected light obviously emerges in every direction, but the nearer one looks along the path of incidence the larger the ratio of illuminated to nonilluminated particles in his line of sight. Indeed, at any appreciable angle from this special direction a considerable proportion of the droplets in one's vision evidently must lie in the shadows of others nearer the surface. Hence, not only will the shadow of one's head be surrounded by the brightest reflected light, like the "heiligenschein" one may see around the shadow of his head on a bedewed lawn, but it will also be the centre of the brightest and only perceptible glory or reflected halo, and that for the simple reason that the more intense the initial light the more brilliant its diffraction effects.

No appreciable difference was noted when the phenomenon was observed along the path of the incidence light forming the shadow, as from a horizontal angle of thirty or more degrees from this path.

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Received December 15, 1953.

Book Reviews

Symposia of the Society for Experimental Biology, No. VII: ***Evolution.*** R. Brown and J. F. Danielli, Eds. New York: Academic Press, 1953. 448 pp. Illus. + plates. $7.80.

A symposium on "Evolution" was held under the auspices of the Society for Experimental Biology, in collaboration with the Genetical Society of Great Britain, at Oxford in July of 1952. The published volume contains contributions of 26 authors, 23 of whom are British, 2 American, and 1 Belgian. Nevertheless, the volume can hardly be said to represent a cross section of current British evolutionary thought. Several well-known figures are absent and, more important, no paleontologists are included. As nearly as one can classify the participants, 10 of them are primarily geneticists, 10 botanists or zoologists, and 6 physiologists and biochemists.

The symposium opens with an interesting though necessarily speculative discussion of the origin of life by J. W. S. Pringle. The formation of prebiotic organic compounds is attributed to branching chain reactions, rather than to ultraviolet radiations postulated by Haldane, Oparin, Bernal, and others. Perhaps the most general statements of modern views of evolutionary mechanisms are contained in the articles of K. Mather on The Genetical Structure of Populations, and of C. H. Waddington on Epigenetics and Evolution. Mather emphasizes that interbreeding Mendelian populations are important units of evolutionary change; Waddington stresses the homeostatic adjustments of the developmental processes brought about by natural selection.

To this reviewer, J. M. Thoday's discussion of the Components of Fitness is most thought provoking. Thoday defines the fitness of a unit of evolution (a Mendelian population or a species) as the probability that it will leave descendants after a lapse of a long period of time, such as 10^8 years. An increase of fitness is defined as evolutionary progress, and a decrease as retrogression. High fitness may be attained by development of genetic population structures which permit sufficient genetic stability together with some evolutionary plasticity, by increasing homeostasis, or by occupation of ecological niches which are preserved more or less intact for a long time. Adaptedness is, then, the ability of the organism to survive and to reproduce under contemporary environmental conditions. The difficulty, perhaps only verbal, with Thoday's definition of fitness is that, as far as this reviewer can see, the primordial virus must be adjudged to have been the fittest creature of all, since it has left most numerous as well as most diversified descendants. The evolutionary line leading to man need not be the most progressive one, since there is no compelling reason to believe that our species will have descendants living 10^8 years hence.

The work of H. Spurway on races and incipient species of newts is important and suggestive. The hybrids between these races show a heterosis in F_1, and a breakdown in F_2 generation and in backcrosses. Is the heterosis a direct consequence of heterozygosis for numerous loci? The hybrid breakdown indicates that the genotypes of the races are integrated adaptive systems which are shattered by recombination. The chromosomes of these races differ by translocations; the origin of the races is, accordingly, best accounted for by genetic drift interacting with selection. Origin of reproductive isolation by natural selection is indi-

cated also for species of *Primula* studied by D. H. Valentine. Another interesting contribution is the study of a blind cave fish from the Congo by M. J. Heuts. According to Heuts, the blindness is not a result of mutation pressure with relaxed selection, but rather of a heterogonic growth connected with low basal metabolism and slow development. Low metabolism is supposed to be favorable in cave environments because of food scarcity. The validity of this interpretation hinges on ecological data omitted from the paper. The complexity of adaptive consequences of some gene changes is emphasized also by P. M. Sheppard, whose study of genetic alterations taking place in a certain natural population of the moth Panaxia is the most thorough of its kind. Quite interesting and original are also P. B. Medawar's discussion of evolutionary problems raised by the viviparity in vertebrates, S. M. Manton's treatment of the locomotion in arthropods, and M. R. A. Chance and A. P. Mead's of social behavior as a factor in the evolution of primates.

The article of C. N. Hinshelwood on adaptation in microorganisms is in a class by itself, aiming as it does to circumvent the evidence that such adaptations occur in many instances through selection of pre-existing mutants. In his foreward to the symposium, J. B. S. Haldane regards Hinshelwood's contribution as "useful in presenting results comparable with those on which Lysenko's criticism of Mendelism is based." The matter is, however, adequately taken care of by M. Demerec and by D. G. Kendall; the occurrence of mutation in microorganisms is no longer in doubt.

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Contact Dermatitis. George L. Waldbott. Springfield, Ill.: Thomas, 1953. 218 pp. Illus. $8.75.

This is an excellent book in a specialized field, written and illustrated in such a manner that it is not only of value to the dermatologist and the allergist but also very readable for the general physician or others interested in this field. It has the unusual distinction of being written by an allergist and edited by a dermatologist.

Although the basic phenomena of contact dermatitis are discussed as to incidence, mechanism, pathology, and diagnosis, with adequate consideration of the determination of the causes by history and patch test, the uncommon feature of the work is the stress laid on the various patterns of contact dermatitis. Various tables and illustrations are helpful to the practicing physician or researcher.

Special situations are considered in separate chapters such as poison ivy, pollen dermatitis, cosmetics, soaps, wearing apparel, drugs, footwear, and occupation. Treatment with special emphasis on the care of poison ivy dermatitis is considered in a separate chapter. The principal contact agents and other contributing irritants are listed and discussed. A glossary together with a very complete bibliography complete the work.

The typography, illustrations, format, and paper are of superior quality.

Although the book does briefly mention the psychosomatic angles of contact dermatitis and emphasizes the misuse of the psychoanalytic approach, the opposite is more likely in the reviewer's opinion, i.e., the contact dermatitis angle of a specific case is much more often overdone by the average physician while losing sight of the nervous factors.

The author has wisely eliminated the chemical analysis of the various contactants leaving this problem more specifically for texts on occupational dermatitis.

This is an excellent book and is highly recommended for those interested in this problem.

RUSSELL J. FIELDS
1835 I Street, NW, Washington, D. C.

Books Reviewed in THE SCIENTIFIC MONTHLY

December

Eugenics: Galton and After. C. P. Blacker. Cambridge, Mass.: Harvard Univ. Press, 1952. 349 pp. $5.00.
Reviewed by C. Nash Herndon.

Introduction to Logical Theory. P. F. Strawson. New York: Wiley; London: Methuen, 1952. 266 pp. $3.50.
Reviewed by Paul C. Rosenbloom.

Along the Great Rivers. Gordon Cooper. New York: Philosophical Library, 1953. 159 pp. + plates. $4.75.
Reviewed by Herbert B. Nichols.

Atoms, Men and God. Paul E. Sabine. New York: Philosophical Library, 1953. 226 pp. $3.75.
Reviewed by A. Cornelius Benjamin.

The Itinerant Ivory Tower. G. E. Hutchison. New Haven, Conn.: Yale Univ. Press; London: Oxford Univ. Press, 1953. 261 pp. $4.00.
Reviewed by Marston Bates.

Succulent Plants: Other Than Cacti. A. Bertrand. New York: Philosophical Library, 1953. 112 pp. Illus. + plates. $4.75.
Reviewed by Edward J. Alexander.

Our Neighbour Worlds. V. A. Firsoff. New York: Philosophical Library, 1953. 336 pp. Illus. + plate. $6.00.
Reviewed by Frank K. Edmondson.

A Free Society. Mark M. Heald. New York: Philosophical Library, 1953. 546 pp. $4.75.
Reviewed by William E. Diez.

Heredity in Health and Mental Disorder. Franz J. Kallmann. New York: Norton, 1953. 315 pp. Illus. $6.00.
Reviewed by Laurence H. Snyder.

The End of the World: A Scientific Inquiry. Kenneth Heuer. New York: Rinehart, 1953. 220 pp. + plates. $3.00.
Reviewed by G. Gamow.

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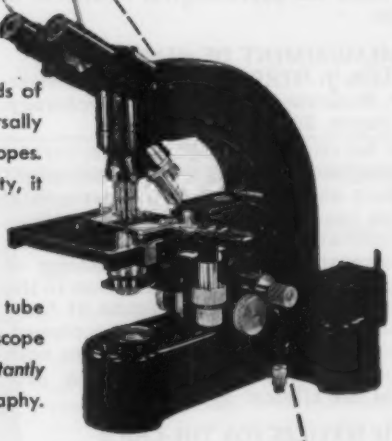

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Meetings & Conferences

February

Feb. 15. American Association for the Advancement of Science, Springfield Chapter, Springfield, Mass. (P. H. Cinis, 73 Melha Ave., Springfield 4.)

15–18. American Inst. of Mining and Metallurgical Engineers, New York City. (E. H. Robie, 29 W. 39 St., New York 18.)

15–18. Soc. of Economic Geologists, New York City. (O. N. Rove, U.S. Geological Survey, Washington 25, D.C.)

19–25. International Management Cong., 10th, São Paulo, Brazil. (P. S. M. Phillips, Management House, Hill St., London W. 1, Eng.)

20–21. American College of Apothecaries, Chicago, Ill. (R. E. Abrams, 2173 Knorr St., Philadelphia, Pa.)

25–27. American Acad. of Forensic Sciences, Chicago, Ill. (R. Turner, Dept. of Police Administration, Michigan State College, East Lansing.)

26–27. American Physical Society, Austin, Tex. (K. K. Darrow, Columbia Univ., New York 27.)

28–4. Pan American Assoc. of Oto-Rhino-Laryngology and Broncho-Esophagology, Mexico City, Mex. (C. L. Jackson, 1901 Walnut St., Philadelphia 3, Pa.)

March

4–5. American Soc. for Metals, mid-winter, Boston, Mass. (W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, Ohio.)

6. Symposium on Air Pollution and Its Control, 2nd annual, Staten Island, N. Y. (N. Colosi, Wagner College, Staten Island, N. Y.)

8–9. National Symposium of Division of Organic Chemistry, Chemical Inst. of Canada, Montreal, Canada. (G. E. McCasland, Dept. of Chemistry, Univ. of Toronto, Toronto, Ont.)

8–10. American Inst. of Chemical Engineers, Washington, D.C. (S. L. Tyler, 120 E. 41 St., New York 17.)

8–10. The Wildlife Soc., annual, Chicago, Ill. (G. A. Petrides, Dept. of Fisheries and Wildlife, Michigan State College, East Lansing.)

9–12. American Mosquito Control Assoc., annual, Atlantic City, N.J. (R. E. Dorer, 301 Essex Bldg., Bank & Plume Sts., Norfolk, Va.)

11–13. American Orthopsychiatric Assoc., New York, N. Y. (M. F. Langer, 1790 Broadway, New York 19.)

11–13. Kappa Delta Pi, Lafayette, Ind. (E. I. F. Williams, 277 E. Perry St., Tiffin, Ohio.)

11–13. National Wildlife Federation, annual, Chicago, Ill. (L. F. Wood, 232 Carroll St., NW, Washington 12, D. C.)

15–19. National Assoc. of Corrosion Engineers, annual, Kansas City, Mo. (A. B. Campbell, 1061 M & M Bldg., Houston 2, Tex.)

16–17. Symposium on Monte Carlo Methods, Gainesville, Fla. (H. A. Meyer, Univ. of Florida, Gainesville.)

18. Inst. of Mathematical Statistics, Eastern regional, Gainesville, Fla. (H. A. Meyer, Univ. of Florida, Gainesville.)

18–20. American Physical Soc., Detroit and Ann Arbor, Mich. (K. K. Darrow, Columbia Univ., New York 27.)

20. The Biochemical Soc., annual, London, Eng. (F. L. Warren, Biochemistry Dept., London Hospital Medical College, London W. 1.)

21. International Assoc. for Dental Research, French Lick, Ind. (E. H. Hatton, 311 E. Chicago Ave., Chicago 11, Ill.)

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